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## The LARST Educational Package Instructor's Notes

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Purdue University, West Lafayette, Indiana

1974

LARSYS EDUCATIONAL PACKAGE

INSTRUCTOR'S NOTES

by

John C. Lindenlaub  
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by the Laboratory for Applications of Remote Sensing,  
Purdue University, West Lafayette, Indiana 47907.

## PREFACE

The materials included in this volume have been designed to assist LARsys instructors as they guide students through the LARsys Educational Package. All of the materials have been updated from the previous version to reflect the changes made in the Educational Package which coincided with the technical changes brought about by putting LARsys Version 3.1 "on line."

Included in the material is "A Survey of the LARsys Educational Package to Accompany Version 3.1," the Student Notes for Units II through V (Units I, VI and VII have been issued as separate LARsys Information Notes) and the Instructor's Notes for each of the seven units now in the package. Instructor's Notes are printed on buff paper.

There are many significant changes in the nature and format of the Educational Package as well as minor changes in the content which reflect changes brought about by LARsys Version 3.1. Unit I has been reduced from 83 pages to 63 pages with no significant changes in content. Diagnostic pretests and posttests have been added to allow the student to check his progress and mastery of the materials presented.

Unit II also has a new format. The earlier version was a notebook or set of slides and audio tape which the student or students viewed rather passively. The new version incorporates a set of student notes which contain activities to actively involve the students in learning. The slides and notebook have been replaced by a display book which makes the computer printouts much more readable. Three decks of computer cards allow the student to handle the materials they will be generating later in the sequence.

Revisions in Units III, IV, and V include those needed for consistency with changes in LARsys, some organizational improvements to increase ease of use by both students and instructors, and numerous smaller changes as suggested by students who had used earlier versions of the LARsys Educational Package. In response to our national resource shortages, steps were also taken to reduce the amount of computer paper needed to carry out the activities. Notable additions to the Demonstration (Unit III) include student follow-up activities, a conference with the instructor, and greater emphasis on the computer system environments and user aids. In Unit IV, students now learn to use the system to communicate with the operator and with other users, and look closely at the details of the typewriter, lineprinter and punched output. In Unit V, they get experience using the batch processor.

Unit VI, Guide to Multispectral Data Analysis Using LARsys, has undergone the least change. Basically only typographical errors were corrected, awkward sentence structures changed and the computer printouts updated to the format generated by LARsys 3.1.

Unit VII, A Case Study Using LARsys for Analysis of LANDSAT Data, is a totally new addition to the Educational Package. It has been designed by Tina Cary to parallel the Guide (Unit VI) but uses data from LANDSAT for the analysis sequence. As in the Guide, the students actually complete a case study.

A Survey of the LARSYS Educational Package  
to Accompany Version 3.1

The LARSYS Educational Package is a set of instructional materials developed to train people to analyze remotely sensed multispectral data using LARSYS, a computer software system developed at LARS/Purdue. A high priority was placed on designing the materials for independent study as it was felt that this would be the most likely situation in practice. Organizations just getting started in the use of multispectral data would probably have only two or three people making initial use of LARSYS. As their experience and skills improve other workers would be expected to join the effort. Students would be starting at different times and, depending on their backgrounds and other duties, would progress at different rates.

To meet these educational challenges, a series of seven units has been developed. Each unit is designed to take a student from an initial point, defined by the prerequisites, to an end point, defined by its objectives. Each unit provides informational materials, an opportunity for the student to practice and study the skills or ideas presented, and a problem or test situation to help him determine whether he has met the objectives of that unit.

A variety of media is used in the educational package, the selection dependent on the nature of the material and the defined objectives of each unit. Reinforcement of certain concepts, such as the multispectral concept and the multi-dimensional statistical approach, is interwoven throughout the package.

Essential to the effective use of the educational package is a "LARSYS expert" or "site expert." Each student should be assigned to one or two persons experienced with LARSYS who can serve as instructors. At LARS/Purdue the instructor would probably be a fellow researcher from within the same program area. At geographically remote sites, the "site expert" would be an individual who has spent anywhere from several days to several weeks at LARS learning about LARSYS. While at LARS he would have had the opportunity to go through the training materials while working with a terminal identical to his remote site terminal and to observe operations in the computer facility. As the number of experienced LARSYS users at a given remote site grows, it is expected that some of them will also assume instructional duties. Instructor notes, designed to assist those serving as instructors, accompany each unit.

The function of the instructor is not to plan and preside over formal classroom sessions, but rather to serve as a tutor helping clarify troublesome points for each student. It is intended that student/instructor sessions be brief with the instructor providing the necessary corrective feedback or encouragement to enable the student to continue on his own.

#### Description of the LARSYS Educational Package

The LARSYS Educational Package presently consists of seven units. A flow chart of the materials is shown on the next page. It summarizes the purpose of each unit and gives a time estimate for completing each unit.

Students begin with a background manual entitled An Introduction to Quantitative Remote Sensing. This is an introduction to remote sensing stressing the role of pattern recognition in numerically-oriented remote sensing systems. Its specific purpose is to provide a common background and orientation for the LARSYS computer software system. For newcomers to remote sensing, this manual introduces concepts and terminology which are needed later on. Remote sensing veterans will be introduced in this material to numerically-oriented remote sensing data analysis.

The second unit entitled LARSYS Software System - An Overview consists of a recorded tape which accompanies a display book and student notes. It takes the viewer through a typical remote sensing data analysis sequence and illustrates the commonly used features of the LARSYS processing functions.

An introduction to the computer terminal follows. The unit Demonstration of LARSYS on a 2780 Remote Terminal provides the student with an introduction to the data processing hardware that he will be using and introduces him to some additional aspects of the LARSYS software system. He will observe several LARSYS jobs run at the 2780 remote terminal. The demonstration requires an instructor to present the material and guide the student. Instructor's notes have been designed so that persons with only a modest amount of experience with the terminal can satisfactorily run the demonstration.

Students are instructed in the use of the terminal by means of an audio-tutorial lesson The 2780 Remote Terminal: A Hands-On Experience. The student is guided by an audio tape on how to use the terminal off-line as a card lister, login to the computer and initiate the LARSYS system, run sample LARSYS jobs and transmit data to and receive data from the main computer. The audio tape is accompanied by a set of student notes.

LARSYS Exercises, Unit V, are short problems which the student solves by using the computer terminal and LARSYS processing functions. The purpose of these problems is to increase the student's experience in the use of LARSYS for multispectral data analysis and to help him develop an appreciation for the capabilities and limitations of the LARSYS software system.

## THE LARSHS EDUCATIONAL PACKAGE

UNIT I

Title: An Introduction to Quantitative Remote Sensing  
Purpose: Orientation to remote sensing terminology,  
principles and pattern recognition.  
Time estimate: 4 hours

UNIT II

Title: LARSHS Software System - An Overview  
Purpose: Summary of LARSHS data analysis capabilities.  
Time estimate: 1 hour

UNIT III

Title: Demonstration of LARSHS on the 2780 Remote Terminal  
Purpose: Orientation to terminal hardware and terminal  
procedures.  
Time estimate: 1.5 hours

UNIT IV

Title: The 2780 Remote Terminal: A "Hands-On" Experience  
Purpose: Experience in transmitting cards, receiving  
punched and printer output, and running a LARSHS program  
when given the control card listings.  
Time estimate: 4.5 hours

UNIT V

Title: LARSHS Exercises  
Purpose: Practice in using the terminal, writing and  
executing simple LARSHS programs.  
Time estimate: 5 hours

Title: Guide to Multispectral Data  
Analysis Using LARSHS (with accompanying  
Example and Case Study)  
Purpose: Analysis of a detailed example  
and a case study using aircraft data.  
Time estimate: 40 hours

Title: A Case Study Using LARSHS for  
Analysis of LANDSAT Data  
Purpose: Analysis approach of a  
detailed example and a case study.  
Time estimate: 45 hours

UNIT VI

UNIT VII

At this point in learning to use LARSYS, the student has a choice between Unit VI, Guide to Multispectral Data Analysis Using LARSYS and Unit VII, A Case Study Using LARSYS for Analysis of LANDSAT Data. Both units provide a detailed breakdown of the philosophy of the analysis methods -- describing the steps in the analysis, why they are necessary and how they are carried out. A detailed example parallels the description, and the student has the opportunity to carry out an analysis of his own by means of a case study. Unit VI is geared toward a supervised analysis approach and uses aircraft data. Unit VII combines techniques from both supervised and unsupervised approaches and applies these techniques to data collected by the Earth Resources Technology Satellite, now known as LANDSAT. If the student has the time, resources and interest, a study of both units is recommended.

#### Other Educational Resources

A Site Library containing selected LARS Information Notes, the LARSYS User's Manual, "An Analysis of Run 71053900" (an analysis example for Unit VI), "An Analysis of Run 73033802" (an analysis example for Unit VII), and copies of Focus is included in the support materials accompanying the LARSYS Educational Package.

Two documents in particular are referenced frequently in the LARSYS Educational Package. They are the LARSYS User's Manual edited by T. L. Phillips, and Pattern Recognition: A Basis for Remote Sensing Data Analysis by P. H. Swain. The former document provides a detailed documentation of the LARSYS system from the user's viewpoint; the latter provides a theoretical framework for the algorithms used in the LARSYS processing functions.

Newcomers to the field are encouraged to do some background reading. The kind and amount of reading will vary according to the specific application of remote sensing in which they are interested. There is a large quantity of technical literature available in remote sensing. However, reading most of it requires a thorough understanding of the technology. Persons new to remote sensing find it most helpful to look at one or more of books written to provide an overview of the field. Generally they discuss the various sensor types, data characteristics, analysis procedures, and applications. We especially recommend five that are currently available.

Committee on Remote Sensing for Agricultural Purposes (1970). Remote Sensing with Special Reference to Agriculture and Forestry. National Academy of Sciences, Wash., D. C. 424 p.

Estes, J. E. and Senger, L. W. (1974). Remote Sensing: Techniques for Environmental Analysis. Hamilton Publishing Co., Santa Barbara, Calif. 340 p.

Holz, R. K. (ed.) (1973). The Surveillant Science: Remote Sensing of the Environment, Houghton, Mifflin Co., Boston. 390 p.

Johnson, P. L. (ed.) (1969). Remote Sensing in Ecology. Univ. of Georgia Press, Athens, Ga. 244 p.

Rudd, R. D. (1974). Remote Sensing: A Better View. Duxbury Press, North Scituate, Massachusetts. 135 p.

Readings from the remote sensing literature may be selected to emphasize the discipline orientation of the student.

Those interested may contact Technology Transfer at LARS to determine other educational materials that are available. Many different types of materials are presently in preparation including additional Focus items, minicourse (which include student notes, slides and audio tapes), and video tapes with viewing notes.

Many people have contributed to the development of the LARSYS Educational Package. Valuable suggestions have come from students working with earlier versions of the educational package. You, as a student, can aid in the further development and improvement of the materials by sending any comments and suggestions to:

John C. Lindenlaub  
Technology Transfer  
Laboratory for Applications of  
Remote Sensing  
1220 Potter Drive  
West Lafayette, Indiana 47906

Special Note to Instructor

Each terminal site has one or more Multispectral Image Storage Tapes assigned to it. The person charged with the responsibility of coordinating educational activities at the site should dedicate one of these tapes to educational purposes. In particular, students will need access to runs 73033802, 66000600, 66005200, 71053900 and 72072302 at one or more times as they go through the educational materials. Each site expert is responsible for generating a tape with these runs on it.<sup>1</sup> This may be accomplished by means of the following LARsys run:

```
*DUPLICATERUN
FROM RUN(73033802)
TO TAPE(TTT), FILE(1)
END
*DUPLICATERUN
FROM RUN(66000600)
TO TAPE(TTT), FILE(2)
END
*DUPLICATERUN
FROM RUN(66005200)
TO TAPE(TTT), FILE(3)
END
*DUPLICATERUN
FROM RUN(71053900)
TO TAPE(TTT), FILE(4)
END
*DUPLICATERUN
FROM RUN(72072302)
TO TAPE(TTT), FILE (5)
END
```

where TTT is the tape number used for educational purposes at your particular site.

---

<sup>1</sup>This particular order was chosen so as to place the run expected to have heaviest use at the beginning of the tape. This results in fewer file forward requirements and hence more efficient operation. Local conditions or case study preferences may dictate a different order at your remote terminal site.

AN INTRODUCTION TO  
QUANTITATIVE REMOTE SENSING

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Instructor's Notes

Materials Required: Student's personal copy of  
An Introduction to Quantitative Remote Sensing  
(LARS Information Note 110474)

Estimate of Instructor time required: Briefing time:  
5 to 10 minutes

Important Notes:

An Introduction to Quantitative Remote Sensing is written like a programmed text. Urge your student to read the Preface first. The material is self-contained and the reader should require no external assistance. Each student should be provided with a personal copy.

The booklet is divided into three sections: I. An Introduction to Remote Sensing, II. Multispectral Analysis and III. The Role of Pattern Recognition in Remote Sensing. Each section is preceded by Objectives and a Pretest (blue page) and followed by a Posttest (yellow pages). The answers for all of the Pretest and Posttest questions are given in the Appendix (pink pages). Encourage the student to actually write out each answer in the spaces provided in the booklet. On the basis of the "correctness" of his answers to these questions, he will be directed to various parts of the text.

Instructors who have used this booklet feel that debriefing students after the Introduction is very important, especially to be sure that they understand the basic concepts such as decision rules.

If your student is a newcomer to remote sensing, you might suggest additional reading from the Site Library. Select materials that emphasize the discipline orientation of the student.

THE LARSH SOFTWARE SYSTEM:  
AN OVERVIEW

---

Instructor's Notes

Materials Required:      Audio tape and tape player  
                                    Booklet of displays  
                                    Three decks of computer cards (A,B and C)  
                                    Student Notes handout (which student will  
                                    keep)

Estimate of Instructor time required:      Briefing time:  
    5 to 10 minutes

Students should be briefed on the operation of the tape player.

You should emphasize this is an overview and that it is not intended that the students absorb all the details. Have them pay close attention to the set of instructional objectives stated at the beginning of the Student Notes.

Student Notes  
for  
**LARSYS**  
software system:  
An Overview

\*LINEGRAPH \*SEPARABILITY  
\*PICTUREPRINT  
\*HISTOGRAM      **LARSYS**  
\*CLASSIFYPOINTS      \*IDPRINT \*STATISTICS  
\*PRINTRESULTS

Developed by James D. Russell and John C. Lindenlaub

Laboratory for Applications of Remote Sensing  
Purdue University, West Lafayette, Indiana 47907

NOTE TO THE STUDENT: This set of notes is designed to accompany an audio tape, a set of display materials and three sample decks, labeled A, B and C. The presentation runs about 45 minutes and is intended as an overview or introductory treatment of the LARSYS software system.

If you have not done so already, begin this minicourse by listening to the audio tape and following the instructions given on the tape. Music on the tape will be your cue to turn off the tape and perform some activity.

PREREQUISITES: Some background in remote sensing and pattern recognition is assumed. Specifically you should be able to:

1. Define "remote sensing."
2. Identify three types of measurable electromagnetic field variations that are used in remote sensing.
3. Given a graph showing relative spectral response vs. wavelength for various ground covers, plot their associated points on the  $\lambda_1, \lambda_2$  plane.
4. Given a plot of training samples associated with different classes of ground cover, classify an unknown point using a specified decision rule.
5. Outline and/or discuss the basic operation of an airborne multispectral scanner.
6. Given a block diagram of a pattern recognition system, discuss the following terms: receptor, feature vector, categorizer, and decision rule.
7. State two conditions a class must meet in order to be useful.

This background material is included in Unit I of the LARSYS Educational Package, entitled An Introduction to Quantitative Remote Sensing. If you do not feel you have met these prerequisites, you may want to reread sections of the Introduction or get additional suggestions from your instructor.

OBJECTIVES: When you have completed this minicourse, you should be able to:

1. List, without regard to the particular format used, the information contained on a multispectral image storage tape.
2. Name the three types of control cards used in running LARSYS programs.
3. Describe the output of at least four of the LARSYS processing functions which are described in this overview.

## WHAT IS LARSHYS?

LARSHYS - A GROUP OF COMPUTER PROGRAMS DESIGNED TO:

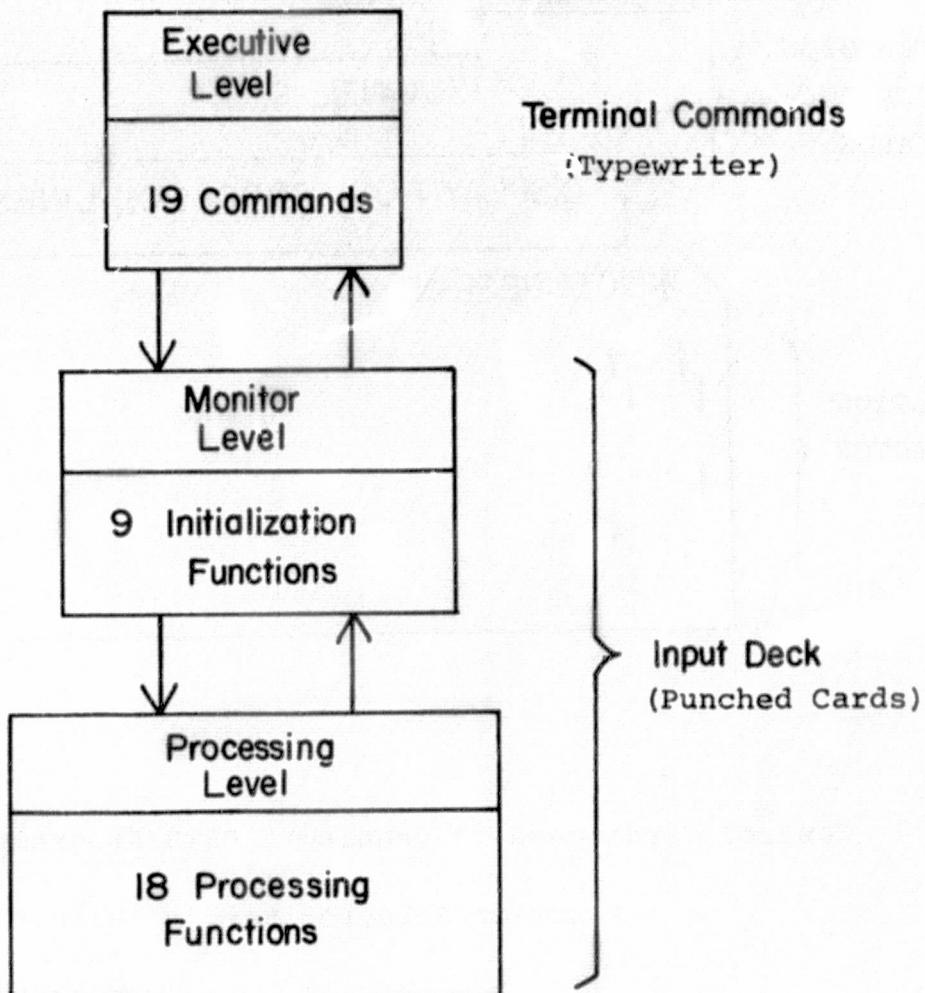
Access

Manipulate

Analyze

a very high volume of data.

Communicated By:



The LARSHYS Organization

Figure 1

## TYPES OF INFORMATION ON MULTISPECTRAL IMAGE STORAGE TAPE

- Identification Information
- Calibration Information
- Data Addresses
- Data Values for each element of the ground scene

LARSYS can be used to obtain ID Information  
from a Multispectral Image Storage Tape

LARSYS can produce Alphanumeric Pictorial Printouts

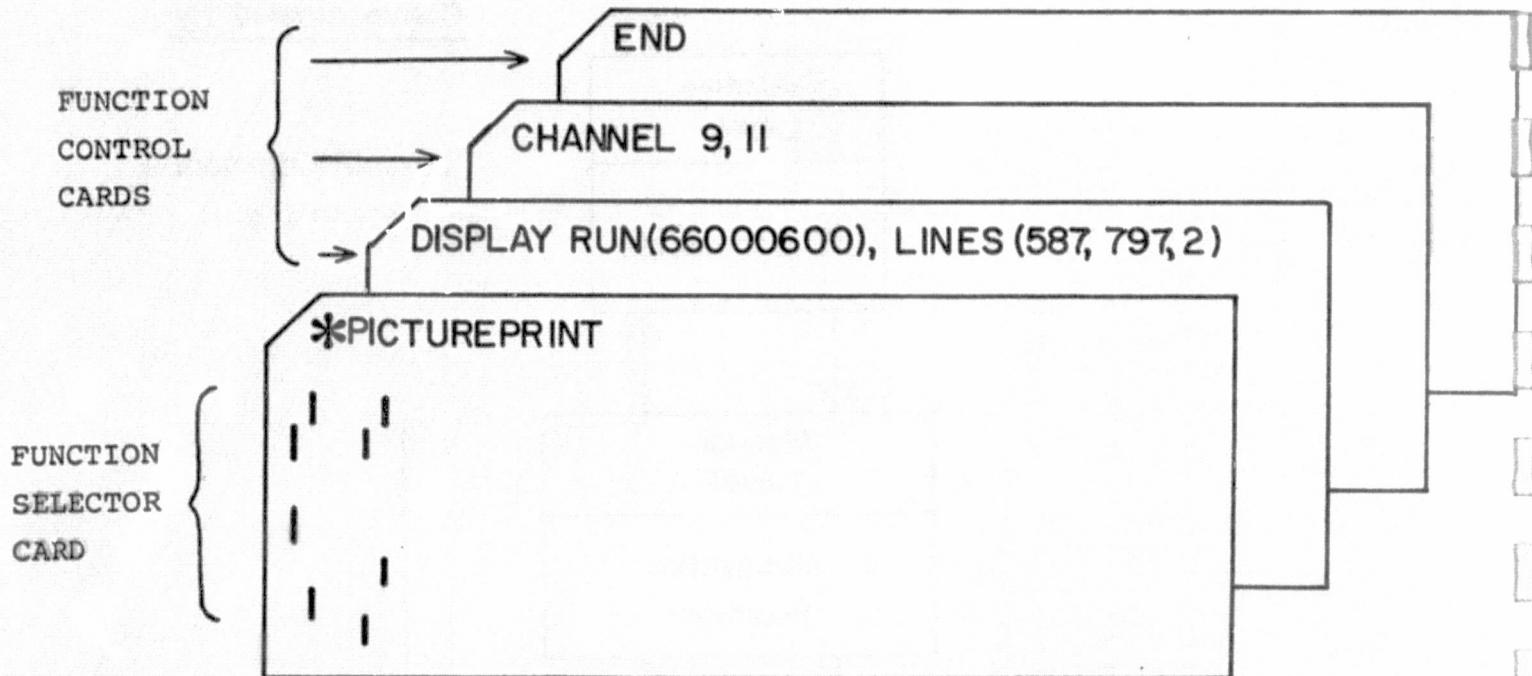


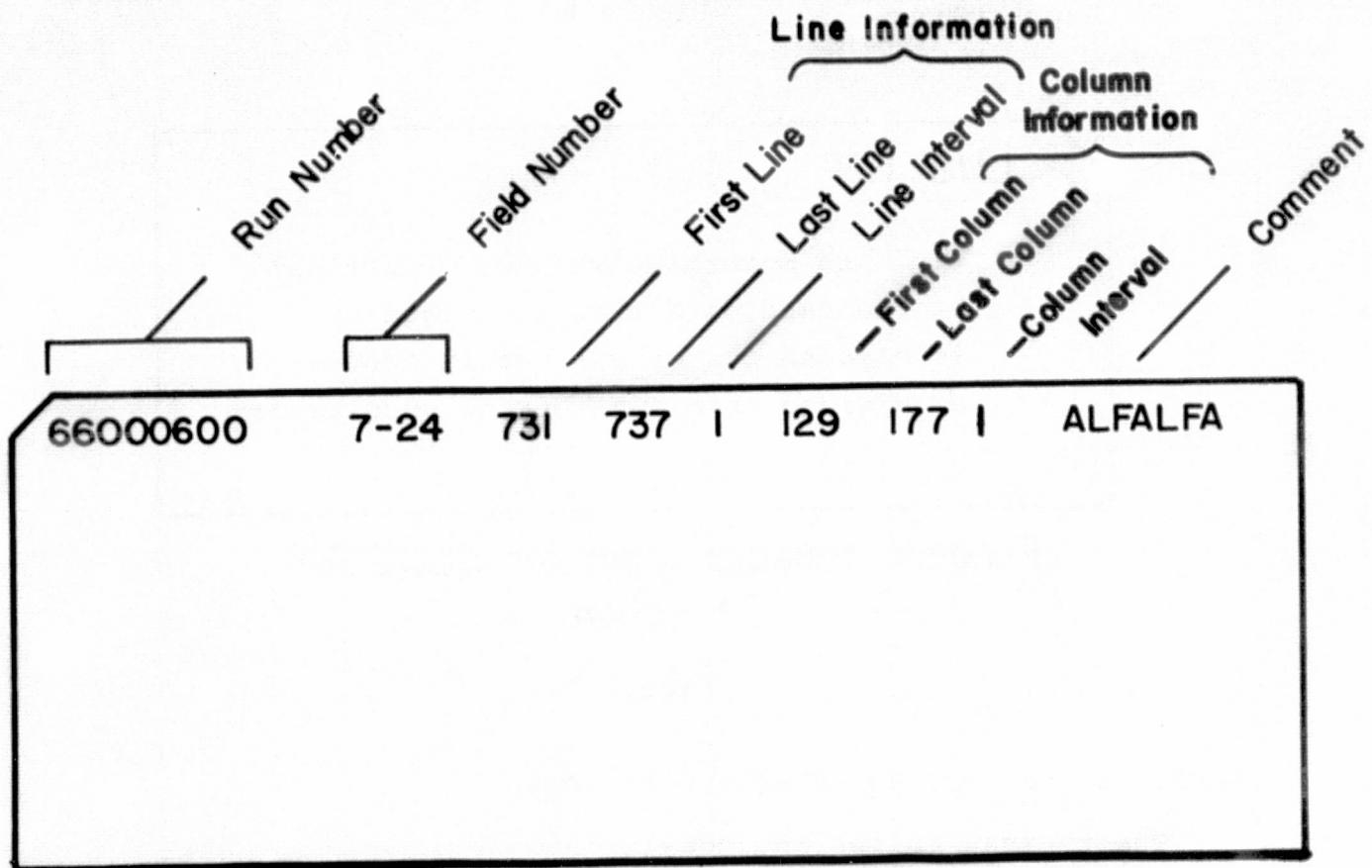
Figure 2

Control Cards used in running LARSYS Programs:

- Function Selector Card - (with \* in column 1, tells which processing function is desired)
- Function Control Cards - (key word begins in column 1, card contains data addresses, computation options, type of output desired, etc.)
- Initialization Function Cards - (with hyphen in column 1, used for "housekeeping" functions such as putting identification comments on output)

THE ANALYST USES REFERENCE DATA TO -

- Locate Training Fields (typical data samples) and Test Fields (to evaluate accuracy of classification results)
- Establish Field Boundaries (by comparing gray scale printout with aerial photograph)



SAMPLE OF FIELD DESCRIPTION CARD

Figure 3

**\*LINEGRAPH**

to produce graphs of  
specified lines (or columns)  
of data -- see Display 8

**Function Selector Card for LINEGRAPH  
Function**

Figure 4

**\*CLUSTER**

to determine whether or not all  
of the candidate training class data  
is homogeneous or whether it should  
be divided into a number of subclasses

**Function Selector Card for CLUSTER  
Function**

Figure 5

LARSYs can be used to CLUSTER data sets.

The typical output includes:

- Maps of candidate training fields
- Statistics for candidate training classes
- Information about separability  
of candidate training classes
- Histograms of data points associated  
with a cluster (optional)

**\*STATISTICS**

to calculate the statistics  
for data fields and data classes  
in any set of channels

### Function Selector Card for STATISTICS Function

Figure 6

LARSYS can provide means, standard deviations, and correlation matrices of data fields and classes.

The STATISTICS processing function produces the statistics deck needed for the SEPARABILITY and CLASSIFYPOINTS processing functions.

LARSYS can provide Histograms of data from individual fields of data and from classes (groups of data fields).

The STATISTICS processing function provides:

- Mean and standard deviation vectors
- Correlation matrices
- Statistics decks
- Histograms
- Coincident spectral plots

LARSYs assists in determining the degree of SEPARABILITY of classes.

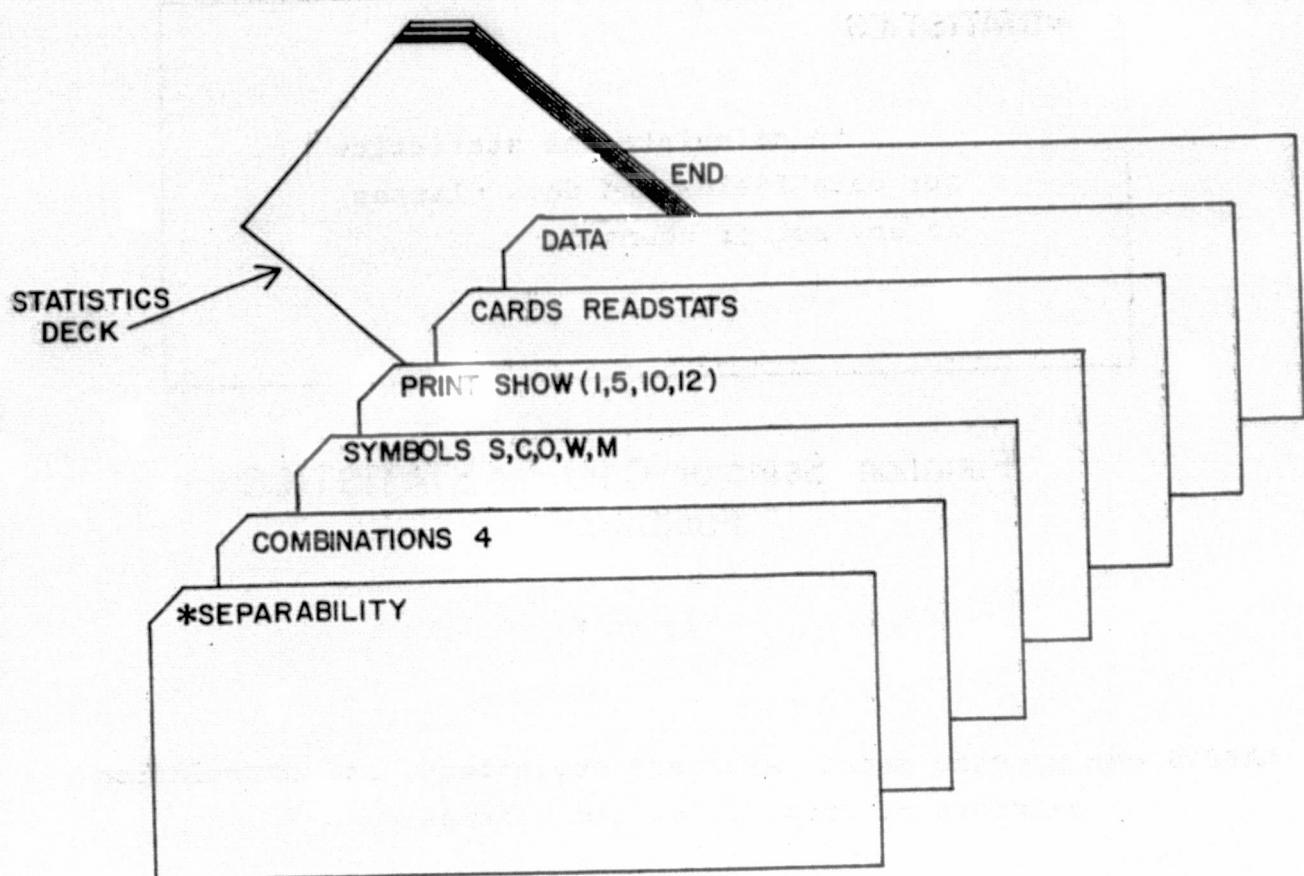


Figure 7

LARSYs helps select the best set of features.

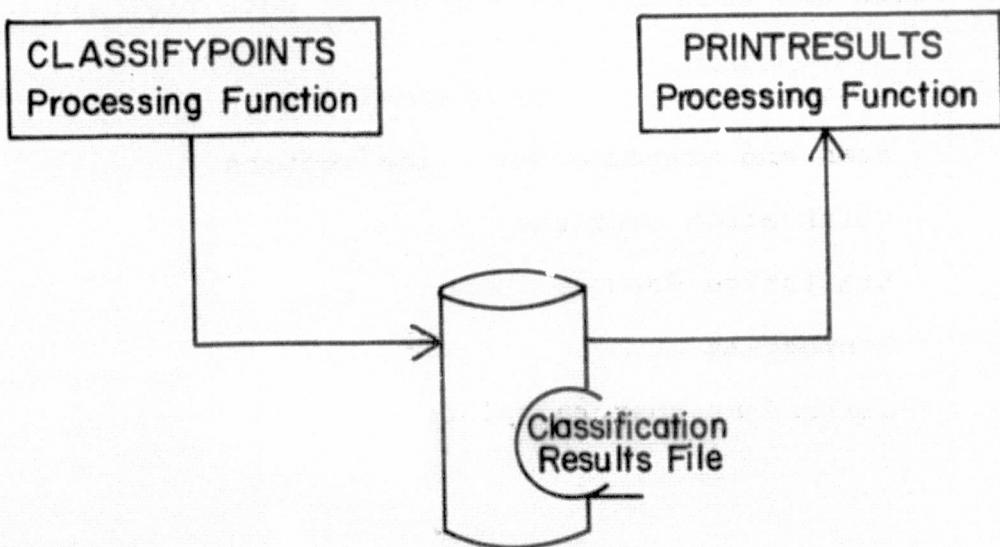


Figure 8

LARSYS can be used to classify data.

Results are displayed in map or tabular form.

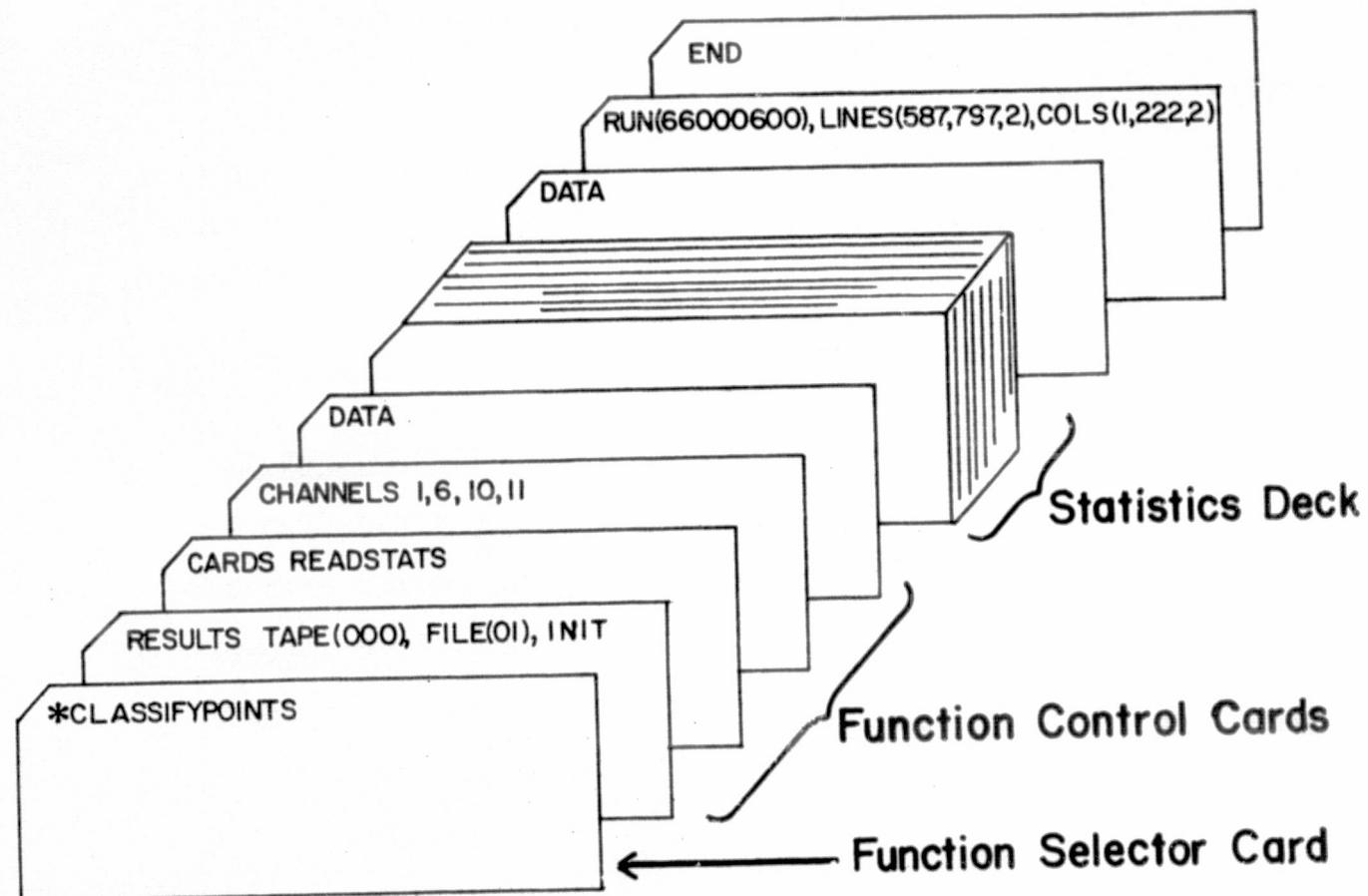


Figure 9

S U M M A R Y

LARSYS uses three types of control cards

- Initialization cards
- Function Selector cards
- Function Control cards

Multispectral Image Storage Tapes contain:

- Data Values
- Data Addresses
- Identification Information
- Calibration Information

LARSYS Function

IDPRINT

PICTUREPRINT

COLUMNGRAPH

LINEGRAPH

CLUSTER

STATISTICS

SEPARABILITY

CLASSIFYPOINTS

PRINTRESULTS

LARSYS Output Examples

Identification Records

Grayscale Printouts

Graphs of Columns

Graphs of Lines

Maps

Statistics

Separability Information

Histograms (optional)

Histograms

Spectral Plots

Mean and Correlation Matrices

Statistics Deck

Statistical Distances between class pairs

Classification File

Classification Maps and Performance Tables

Remember, this is an "overview." You are not expected to learn the details of the data processing procedure at this stage in your study.

Self-Check

A. The data source for the LARSYS processing functions is the Multispectral Image Storage Tape. It contains the following information:

- 1.
- 2.
- 3.
- 4.

B. What are the three types of control cards used in running LARSYS programs?

- 1.
- 2.
- 3.

C. Briefly describe the output of at least four of these Processing Functions.

\*IDPRINT

\*PICTUREPRINT

\*COLUMNGRAPH, \*LINEGRAPH

\*CLUSTER

\*STATISTICS

\*SEPARABILITY

\*CLASSIFYPOINTS

\*PRINTRESULTS

DEMONSTRATION OF LARSHY  
ON THE 2780 REMOTE TERMINAL

---

Instructor's Notes

Preface to the Instructor

This instructor's guide is designed to help you give a "first time" demonstration of the 2780 remote terminal. We have assumed that you are already familiar with the terminal and use the terminal in your daily activities. If you are a knowledgeable but infrequent user of the terminal, go through a "dry run" of the demonstration before presenting it to your students. For your convenience, the three decks used in the demonstration are listed in the Appendices to these notes.

Materials required:     Student Notes  
                                 Control card decks (3)  
                                 Instructor's Notes

Time Estimate:         The demonstration can be completed in one hour if the demonstrator doesn't talk too much. One and a half hours is typical.

Terminal sign-up and tape drive requirements:     Insure your access to the terminal; reserve the terminal according to local procedures. Observe current LARS procedures for reserving tape drives.

LARSYS Demo  
Instructor's Notes

STEPS IN CARRYING OUT THE DEMONSTRATION

I. Before you meet the student

1. Read the Instructor's Notes and Student Notes; locate the required control card decks.
2. Check to see that one of the Multispectral Image Storage Tapes assigned to your terminal site has a copy of run 66000600 on it. If it does, enter the tape number and file number below for easy reference:

Tape TTT = \_\_\_\_\_; File F = \_\_\_\_\_.

If it does not, see page 6 of "A Survey of the LARSYS Educational Package" at the front of these Instructor Notes.

3. Check the control card decks used with this demonstration. Make sure each deck includes a RUNTABLE initialization function to call into use your tape with run 66000600 on it. The deck setup should be:

```
-RUNTABLE
DATA
RUN(66000600), TAPE(TTT), FILE(F)
END
```

where TTT and F are the tape and file number determined in step 2 above.

II. Preliminary Talk with Student

1. Talk to the student and determine what he knows about remote sensing, pattern recognition and LARSYS. See if he has any questions as a result of going through the LARSYS Software System - An Overview. (Unit II)
2. If the student is already somewhat familiar with the hardware, he may find this unit more interesting if you let him do as much of the demonstration himself as he can; as you tell him each step that needs to be demonstrated, he can carry out the demonstration for you.
3. If the student is unfamiliar with the hardware, assure him that he is not expected to run LARSYS unaided at the conclusion of this demonstration. The "Hands-On" experience in the next unit will teach him one-by-one the steps he needs to know.

LARSYs Demo  
Instructor's Notes

III. The Demonstration

Step

1

Orientation to  
physical setup

2

Use 2780 off-line to  
list control cards

3

Login, type name  
initiate LARSYs

4

Request NEWS, REFERENCE ALL  
send message to operator

5

Read cards

Run STATISTICS job

6,7

Run CLASSIFYPOINTS job

8

Run PRINTRESULTS job; when requested type:  
threshold 6\*0.1

Logout

Details of each step are on pages 4 and 5.

LARSYs Demo  
Instructor's Notes

Step 1. Orient student to the physical setup.

- a. point out terminal documentation, LARSYs User's Manual, bulletin board, etc.
- b. describe sign-up procedures for terminal and tape drives, when applicable.
- c. point out and show controls, on/off switches on:  
card reader/punch  
printer  
typewriter  
data modem

Refer student to Figure 1 in Student's Notes.

- d. give student the name of the terminal coordinator and the person to see if a malfunction occurs. For your own reference, fill in the blanks below:

Terminal coordinator at this site is \_\_\_\_\_.

Person to contact if the printer is out of paper or if a malfunction occurs is \_\_\_\_\_.

Step 2. Demonstrate use of the 2780 off-line as a card lister.

- a. using the deck labeled "for listing" demonstrate:  
card loading  
mode switch (use off-line position)  
printer operation
- b. give listing to student

Step 3. Demonstrate LARSYs Control Commands.

- a. login - (getting "on the air"); and enter name
- b. i larsys - (initiate LARSYs)
- c. news - (this is the system bulletin board)
- d. reference all - (mention that system has numerous user aids such as NEWS, REFERENCE, and LIST control commands. Student will need the LARSYs control card listing to do his future assignments. Point out how easily control card listings are obtained.)
- e. msg operator - I'm demonstrating system; if you get this message, please respond.

LARSYs Demo  
Instructor's Notes

Step 4. Demonstrate how cards are read. Use deck labeled STATISTICS.

- a. point out need for ID card and what happens if you forget the ID card (cards won't read).
- b. point out need to hit End-of-File before last card is read and how to recover if forgotten (load a blank card, hit EOF and read blank card).
- c. point out computer response to a successful transfer of cards (typewriter message).

Step 5. Run the STATISTICS job read in above (type 'run larsys').

- a. While STATISTICS is running, read in all the remaining control cards (CLASSIFYPOINTS and PRINTRESULTS). Point out that you can read in cards for another job while running one job.
- b. Demonstrate receiving printer output.
- c. Demonstrate receiving punched output. Point out why you should use plenty of cards (if you run out of cards you can load more and START again but you may get some duplicate cards).

Step 6. Run the CLASSIFYPOINTS AND PRINTRESULTS jobs (type 'run larsys').

- a. Point out progress messages; they let one know that the program is running.
- b. Point out how you can receive output from one job while running a second job.

Step 7. Correct (intentional) control card error in PRINTRESULTS deck.

- a. An error was deliberately made on a control card in the PRINTRESULTS program. When asked to type the correct card type:

threshold 6\*0.1

- b. If you have not already done so, this is a good time to demonstrate how to recover from a typing error. (@ to delete a single character, \$ to delete a whole line.)
- c. You might also point out that by using the initialization card -TYPE in the card deck, you can enter control cards from the typewriter.

Step 8. Logout (type 'quit'). Obtain printer and punched output.

LARSYS Demo  
Instructor's Notes

Points to emphasize during the demonstration:

LARSYS progress messages

LARSYS error messages and diagnostics

The three environments: Control Program (CP) Command Environment

LARSYS Command Environment

LARSYS Processor Environment

(See Figure 2 in Student Notes)

How to send messages to the computer operator

At the end of the demonstration:

-If more than one student is witnessing the demonstration, supply each student with a copy (either original or Xerox) of the following:

- 1) listing of control cards used
- 2) the typewriter output
- 3) the printer output

Note: it would be reasonable for students to share the same output deck

-Be sure the student understands what he is to do with the output. Schedule a follow-up conference with him.

IV. Follow-up Conference

Go through the objectives with the student to:

- help him find answers to questions he has
- reinforce the material presented in the unit

Be certain that the student feels satisfied with the work he did with the output from the demonstration.

Make plans for doing the next unit, the "Hands-On Experience."

Appendix I: For Listing

DEMONSTRATION OF REMOTE TERMINAL

```
-COMMENT DEMONSTRATION OF THE 2780 REMOTE TERMINAL
-RUNTABLE
DATA
RUN(66000600),TAPE(TTT),FILE(F)
END
*STATISTICS
PRINT HIST(C),CORRE(C)
PUNCH CHARACTERS
CHANNELS 1,2,3,4,5,6,7,8,9,10,11,12
OPTION HIST(1,8,12)
CATA
CLASS SOYBEANS
66000600 31-13    237  253  1    141  167  1    SOYBN
66000600 36-7     307  327  1    59   81   1    SOYBN
CLASS CORN
66000600 36-9     267  283  1    45   61   1    CORN
66000600 36-8     319  341  1    21   31   1    CORN
CLASS OATS
66000600 6-2      365  373  1    145  185  1    OATS
66000600 1-11     421  455  1    63   83   1    OATS
CLASS WHEAT
66000600 31-12    295  303  1    134  175  1    WHEAT
66000600 6-14     471  495  1    177  201  1    WHEAT
CLASS RED CLVR
66000600 6-10     439  447  1    139  183  1    RED CLVR
66000600 1-1      539  565  1    175  195  1    RED CLVR
CLASS ALFALFA
66000600 7-24     731  737  1    129  177  1    ALFALFA
END
*
*
END OF FIRST DEMONSTRATION JOB.
*
```

Note: TTT and F should be replaced by the appropriate tape and file numbers for your location.

```
-COMMENT DEMONSTRATION OF THE 2780 REMOTE TERMINAL
-RUNTABLE
DATA
RUN(66000600),TAPE(TTT),FILE(F)
END
*CLASSIFYPOINTS
RESULTS DISK
CHANNELS 1,6,10,11
CARDS READSTAT
DATA
*
*
*
STATISTICS DECK IN THIS LOCATION
*
*
*
DATA
RUN(66000600),LINES(271,711,2),CCL(1,222,2)
END
```

REPRODUCIBILITY OF THE  
ORIGINAL PAGE IS POOR

(Continued)

```

*PRINTRESULTS
RESULTS DISK
PRINT OUTLINE(TRAIN,TEST), TRAIN(F,C), TEST(F,C,P)
SYMBOLS S,C,O,W,R,A
BHRESHOLD6*.01
*
*
*
ERROR IN THRESHOLD CARD. CORRECTION ENTERED FROM TYPEWRITER.
*
*
*
TEST 1
66000600 12-3 705 797 2 69 111 2 SOYBN E PRT PR SOYBN
66000600 36-7 291 341 2 43 97 2 SOYBN VOLUNTR CORN
66000600 6-9 489 519 2 115 161 2 SOYBEANS
66000600 7-27 643 663 2 125 197 2 SOYBEANS
66C00600 12-7 647 699 2 51 87 2 SOYBEANS
66000600 12-2 647 675 2 93 111 2 SOYBEANS
66000600 12-3 705 797 2 33 63 2 SOYBN W. PRT PLT ERL
TEST 2
66000600 36-9 261 287 2 39 65 2 CORN
66000600 36-8 307 349 2 19 35 2 CORN
66000600 6-11 401 421 2 111 199 2 CORN
66000600 12-9 589 643 2 3 43 2 CORN DIFF VARIETIES
TEST 3
66000600 31-11 327 335 2 109 197 2 OATS
66000600 6-2 365 377 2 131 183 2 OATS DITCH W END
66000600 1-11 413 467 2 45 93 2 OATS
66000600 7-1 583 605 2 121 193 2 OATS
TEST 4
66000600 31-12 285 317 2 109 199 2 WHEAT
66000600 6-1 347 353 2 107 205 2 WHEAT
66000600 6-1 385 393 2 109 203 2 WHEAT
66C00600 6-14 459 509 2 167 211 2 WHT 2 VARIETIES
66000600 7-2 581 689 2 203 211 2 WHEAT
66000600 12-10 649 699 2 3 43 2 WHEAT 2 VAR LODGING
TEST 5
66000600 1-1 357 399 2 61 95 2 RED CL HAY
66000600 6-10 433 453 2 113 197 2 RED CL HAY
66000600 6-7 521 561 2 173 215 2 RED CL PASTURE
66000600 1-6 559 581 2 49 109 2 RED CL PASTURE
66000600 12-8 589 633 2 49 109 2 RED CL PASTURE
66000600 7-29 613 619 2 121 183 2 RD CL DIVERTED ACRES
66000600 7-28 629 637 2 123 191 2 RED CL HAY
END

```

\*\*\*\*\*END OF DEMO LISTING DECK\*\*\*\*\*

REPRODUCIBILITY OF THE  
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Appendix II: Statistics

```
-RUNTABLE
DATA
RUN(66000600),TAPE(TTT),FILE(F) ← See note in Appendix I
END
- COMMENT DEMONSTRATION OF THE 2780 REMOTE TERMINAL
*STATISTICS
PRINT HIST(C),CORRE(C)
PUNCH CHARACTERS
CHANNELS 1,2,3,4,5,6,7,8,9,10,11,12
OPTIONS HIST(1,8,12)
DATA
CLASS SOYBEANS
66000600 31-13    237  253  1    141  167  1    SOYBN
66000600 36-7     307  327  1    59   81   1    SOYBN
CLASS CORN
66000600 36-9     267  283  1    45   61   1    CORN
66000600 36-8     319  341  1    21   31   1    CORN
CLASS OATS
66000600 6-2      365  373  1    145  135  1    OATS
66000600 1-11     421  455  1    63   83   1    OATS
CLASS WHEAT
66000600 31-12    295  303  1    134  175  1    WHEAT
66000600 6-14     471  495  1    177  201  1    WHEAT
CLASS RED CLVR
66000600 6-10     439  447  1    139  183  1    RED CLVR
66000600 1-1      539  565  1    175  195  1    RED CLVR
CLASS ALFALFA
66000600 7-24     731  737  1    129  177  1    ALFALFA
END
```

REPRODUCIBILITY OF THE  
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Appendix III: Classifypoints;Printresults

-COMMENT DEMONSTRATION OF THE 2780 REMOTE TERMINAL

-RUNTABLE

DATA  
RUN(66000600),TAPE(TTT),FILE(F)

See note in Appendix I

END

\*CLASSIFYPOINTS

RESULTS DISK

CHANNELS 1,6,10,11

CARDS READSTATS

DATA

LARsys VERSION 3 STATISTICS FILE

CLASS SOYBEANS

66000600 31-13 237 253 1 141 167 1 SOYBN

66000600 36-7 307 327 1 59 81 1 SOYBN

CLASS CORN

66000600 36-9 267 283 1 45 61 1 CORN

66000600 36-8 319 341 1 21 31 1 CORN

CLASS OATS

66000600 6-2 365 373 1 145 185 1 OATS

66000600 1-11 421 455 1 63 83 1 OATS

CLASS WHEAT

66000600 31-12 295 303 1 134 175 1 WHEAT

66000600 6-14 471 495 1 177 201 1 WHEAT

CLASS RED CLVR

66000600 6-10 439 447 1 139 183 1 RED CLVR

66000600 1-1 539 565 1 175 195 1 RED CLVR

CLASS ALFALFA

66000600 7-24 731 737 1 129 177 1 ALFALFA

6 CLASS 11 FIELD 12 CHANNELS

CHAN 1 WAVELENGTH 0.40- 0.44 CODE 1 CO 31.00 C1 41.05 C2 63.05

CHAN 2 WAVELENGTH 0.44- 0.46 CODE 1 CO 31.00 C1 42.45 C2 67.30

CHAN 3 WAVELENGTH 0.46- 0.48 CODE 1 CO 31.00 C1 41.85 C2 63.05

CHAN 4 WAVELENGTH 0.48- 0.50 CODE 1 CO 31.00 C1 44.90 C2 72.05

CHAN 5 WAVELENGTH 0.50- 0.52 CODE 1 CO 31.00 C1 59.10 C2 128.40

CHAN 6 WAVELENGTH 0.52- 0.55 CODE 1 CO 31.00 C1 66.25 C2 139.35

CHAN 7 WAVELENGTH 0.55- 0.58 CODE 1 CO 31.00 C1 59.45 C2 119.65

CHAN 8 WAVELENGTH 0.58- 0.62 CODE 1 CO 31.00 C1 94.80 C2 229.40

CHAN 9 WAVELENGTH 0.62- 0.66 CODE 1 CO 31.00 C1 96.90 C2 232.30

CHAN 10 WAVELENGTH 0.66- 0.72 CODE 1 CO 31.00 C1 126.40 C2 248.70

CHAN 11 WAVELENGTH 0.72- 0.80 CODE 1 CO 31.00 C1 100.50 C2 221.40

CHAN 12 WAVELENGTH 0.80- 1.00 CODE 1 CO 31.00 C1 85.30 C2 214.50

NO. PTS. 942 542 1104 1003 972 343

MN 0.8442569E 02 0.7915286E 02 0.6117137E 02 0.6182059E 02 0.8450848E 02

MN 0.8660721E 02 0.6356262E 02 0.8212631E 02 0.6880997E 02 0.8021231E 02

MN 0.9208810E 02 0.7259978E 02 0.5952532E 02 0.5969740E 02 0.8178966E 02

MN 0.8367711E 02 0.7751291E 02 0.7562915E 02 0.6091144E 02 0.7201476E 02

MN 0.1105018E 03 0.8375461E 02 0.5837680E 02 0.5916666E 02 0.8139764E 02

MN 0.7725090E 02 0.74270783E 02 0.8686322E 02 0.7283694E 02 0.8925452E 02

MN 0.8583694E 02 0.6454980E 02 0.9016550E 02 0.8157127E 02 0.9231604E 02

MN 0.1059438E 03 0.8336230E 02 0.5720239E 02 0.5884346E 02 0.7857527E 02

MN 0.7105383E 02 0.6998404E 02 0.9016550E 02 0.8157127E 02 0.9231604E 02

MN 0.7931406E 02 0.6205782E 02 0.5415123E 02 0.5394341E 02 0.7136830E 02

MN 0.7802393E 02 0.6581256E 02 0.6888271E 02 0.5501337E 02 0.7507304E 02

MN 0.7226749E 02 0.6888271E 02 0.6816151E 02 0.5501337E 02 0.7507304E 02

MN 0.7828703E 02 0.5731172E 02 0.6816151E 02 0.5501337E 02 0.7507304E 02

MN 0.1346913E 03 0.1046533E 03 0.5570845E 02 0.5583382E 02 0.7608162E 02

MN 0.7714577E 02 0.7186005E 02 0.7060349E 02 0.5524197E 02 0.7898833E 02

MN 0.8580466E 02 0.6116034E 02 0.7060349E 02 0.5524197E 02 0.7898833E 02

MN 0.1491545E 03 0.1100408E 03 0.5570845E 02 0.5583382E 02 0.7608162E 02

CV 0.7787777E 01 0.6143146E 01 0.7870337E 01 0.4498446E 01 0.4144777E 01

CV 0.3949139E 01 0.4292180E 01 0.4311194E 01 0.2889546E 01 0.3726546E 01

CV 0.8451747E 01 0.8343015E 01 0.5540514E 01 0.5869219E 01 0.1330864E 01

CV 0.7542513E 01 0.7656281E 01 0.5028300E 01 0.5331158E 01 0.1049431E 01

CV 0.1084025E 02 0.4912204E 01 0.4861828E 01 0.3458930E 01 0.3472991E 01

CV 0.6583952E 01 0.6122395E 01 0.4813820E 01 0.6971671E 01 0.7015737E 01

CV 0.4731706E 01 0.5086450E 01 0.9735908E 01 0.8813752E 01 0.5685491E 01

CV 0.1017850E 02 0.4773855E 01 0.5040768E 01 0.3364275E 01 0.363821E 01

CV 0.6905440E 01 0.6169704E 01 0.4284496E 01 0.6644647E 01 0.6402748E 01

CV 0.4924401E 01 0.5011080E 01 0.3585127E 01 0.3597110E 01 0.6988630E 01

CV 0.6338529E 01 0.4429833E 01 0.6509813E 01 0.5146657E 01 0.6751899E 01

CV 0.5351399E 01 0.4914252E 01 0.3793545E 01 0.3449405E 01 0.7187880E 01

CV 0.7697769E 01 0.4917429E 01 0.4818825E 01 0.2722392E 01 0.4363844E 01

CV 0.2207405E 02 0.1829420E 01 0.1618098E 01 0.9445636E 00 0.1148102E 01

CV 0.2380129E 01 0.2795877E 01 0.1498525E 01 0.1736052E 01 0.9578767E 00

CV 0.1482511E 01 0.4599593E 01 0.5908735E 01 0.1736052E 01 0.9578767E 00

CV 0.1460720E 02 0.1175187E 02 0.1294161E 02 0.7160851E 01 0.6315746E 01

CV 0.4992862E 01 0.6748702E 01 0.6591715E 01 0.3695445E 01 0.4669827E 01

CV 0.1330350E 02 0.1241492E 02 0.7375128E 01 0.7193171E 01 0.1565623E 02

CV 0.9859072E 01	0.9555987E 01	0.5288501E 01	0.5703589E 01	0.1052970E 02	70
CV 0.9555303E 01	0.5853765E 01	0.5667624E 01	0.3504378E 01	0.3652427E 01	71
CV 0.6191963E 01	0.5307538E 01	0.4443285E 01	0.1000204E 02	0.1034029E 02	72
CV 0.5862646E 01	0.6229539E 01	0.1161317E 02	0.9547868E 01	0.6161450E 01	73
CV 0.1346111E 02	0.7413127E 01	0.8307984E 01	0.4390461E 01	0.5152451E 01	74
CV 0.8948066E 01	0.7655953E 01	0.5327738E 01	0.1039963E 02	0.1042637E 02	75
CV 0.6677602E 01	0.7500732E 01	0.4278730E 01	0.4616303E 01	0.8369099E 01	76
CV 0.7166706E 01	0.5252831E 01	0.9901972E 01	0.8838648E 01	0.1019941E 02	77
CV 0.4088397E 01	0.1119200E 01	0.1556329E 01	0.1521304E 00	0.2200019E 01	78
CV 0.2265061E 01	0.2617334E 00	0.298729E 01	0.4962867E 01	0.2748640E 01	79
CV 0.3581422E 02	0.1244098E 01	0.8543015E 01	0.1405999E 00	0.1390823E 00	80
CV 0.4418222E 00	0.1341028E 01	0.2569418E 01	0.2056049E 01	0.2676115E 01	81
CV 0.2114671E 01	0.1245979E 02	0.1379734E 02	0.1475633E 01	0.3480809E 01	82
CV 0.9325022E 01	0.6099709E 01	0.7200381E 01	0.2105772E 01	0.2936838E 01	83
CV 0.3547820E 01	0.3382442E 01	0.3358265E 01	0.494862E 01	0.1285987E 02	84
CV 0.9063329E 01	0.7623847E 01	0.5202701E 01	0.494862E 01	0.1285987E 02	85
CV 0.9915551E 02	0.8320716E 01	0.4999842E 01	0.4726201E 01	0.1181648E 02	86
CV 0.1520458E 02	0.5644333E 01	0.4701364E 01	0.3293087E 01	0.2972650E 01	87
CV 0.6575366E 01	0.7584739E 01	0.5426346E 01	0.5290921E 01	0.6001719E 01	88
CV 0.4059744E 01	0.4247658E 01	0.8296504E 01	0.7450027E 01	0.5398932E 01	89
CV 0.1250983E 02	0.1183284E 01	0.3369673E 01	0.2137648E 01	0.3094288E 01	90
CV 0.3845490E 01	0.2089439E 01	0.3082472E 01	0.1026780E 02	0.1299968E 02	91
CV 0.2881681E 01	0.24245599E 01	0.3048156E 01	0.3555001E 01	0.5575939E 01	92
CV 0.4074175E 01	0.4314143E 01	0.110465E 02	0.1163719E 02	0.1383271E 02	93
CV 0.9420268E 01	0.4778596E 01	0.3420093E 01	0.1517075E 01	0.7311563E 01	94
CV 0.11197996E 02	0.5291349E 01	0.3815485E 01	0.1140808E 02	0.7376445E 01	95
CV 0.4225975E 02	0.2920795E 01	0.1111212E 01	0.4811190E 01	0.1943185E 00	96
CV 0.1883900E 01	0.42274902E 01	0.1359993E 01	0.2926826E 01	0.5876502E 01	97
CV 0.4009802E 01	0.1487077E 02	0.1347696E 02	0.2952166E 01	0.3375486E 01	98
CV 0.4396299E 01	0.3504851E 01	0.5973797E 01	0.2694386E 01	0.3609206E 01	99
CV 0.3686541E 01	0.2641170E 01	0.3601292E 01	0.5238840E 01	0.1152801E 02	100
CV 0.5046841E 01	0.6558087E 01	0.499722E 01	0.48545597E 01	0.8869050E 01	101
CV 0.4224591E 01	0.5740543E 01	0.4391463E 01	0.3233793E 01	0.386306E 01	102
CV 0.9331409E 01	0.3036803E 01	0.3840244E 01	0.6021020E 01	0.8113420E 01	103
CV 0.6253127E 01	0.6117549E 01	0.5343958E 01	0.1250486E 02	0.9112176E 01	104
CV 0.6179044E 01	0.6894196E 01	0.1321707E 02	0.1250486E 02	0.6954782E 01	105
CV 0.2071309E 02	0.6016118E 01	0.8088963E 01	0.6152723E 01	0.2126711E 02	106
CV 0.12955546E 02	0.1244316E 02	0.9316233E 01	0.1970175E 02	0.1740881E 02	107
CV 0.8069793E 01	0.1050305E 02	0.8300241E 01	0.9256107E 01	0.3924631E 02	108
CV 0.1665013E 02	0.1265236E 02	0.2668616E 02	0.2738612E 02	0.1004111E 02	109
CV 0.4693321E 01	0.57668845E 01	0.4816509E 01	0.5247262E 01	0.2354033E 02	110
CV 0.1063918E 02	0.8282047E 01	0.1628545E 02	0.1613800E 02	0.4265041E 01	111
CV 0.26332877E 02	0.4055011E 01	0.5197605E 01	0.3951147E 01	0.1244751E 02	112
CV 0.8392366E 01	0.8403236E 01	0.5686913E 01	0.1300011E 02	0.1244751E 02	113
CV 0.1770001E 02	0.1295060E 02	0.1342990E 02	0.2640245E 01	0.2197982E 01	114
CV 0.5417562E 01	0.3579293E 01	0.4849257E 01	0.1646053E 01	0.2498340E 01	115
CV 0.2583695E 01	0.2520815E 01	0.2467094E 01	0.3286567E 01	0.8199942E 01	116
CV 0.5005395E 01	0.4760028E 01	0.3161542E 01	0.2850450E 01	0.5941545E 01	117
CV 0.4289773E 01	0.4190239E 01	0.2550777E 01	0.213466E 01	0.2180375E 01	118
CV 0.6705372E 01	0.3019516E 01	0.2803848E 01	0.213466E 01	0.5186831E 01	119
CV 0.3995263E 01	0.3789935E 01	0.3586555E 01	0.5159633E 01	0.4563396E 01	120
CV 0.3489450E 02	0.3899982E 01	0.7824073E 01	0.6356266E 01	0.3067698E 01	121
CV 0.1041364E 02	0.3557695E 01	0.3968614E 01	0.2466564E 01	0.7059553E 01	122
CV 0.5598570E 01	0.4410163E 01	0.3386146E 01	0.7301647E 01	0.5683676E 01	123
CV 0.4258505E 01	0.3878812E 01	0.2538890E 01	0.2619997E 01	0.3853810E 01	124
CV 0.5826591E 01	0.3785650E 01	0.5790455E 01	0.3853810E 01	0.7723804E 01	125
CV 0.8365055E 00	0.3128923E 01	0.1717435E 01	0.4925824E 01	0.5267256E 01	126
CV 0.3791051E 01	0.1267231E 01	0.1561539E 02	0.1749741E 02	0.1047159E 02	127
CV 0.1803907E 03	0.2110344E 01	0.1838565E 00	0.8218681E 00	0.1809546E 01	128
CV 0.1692974E 01	0.4662957E 01	0.3172528E 00	0.7263199E 01	0.9063329E 01	129
CV 0.8078904E 01	0.1010772E 03	0.7568707E 02	0.7765417E 00	0.9766252E 00	130
CV 0.2218453E 01	0.1152038E 01	0.3103166E 01	0.8783097E 00	0.1881660E 01	131
CV 0.1850425E 01	0.8633476E 00	0.1307085E 01	0.1209512E 01	0.3876357E 01	132
CV 0.1186895E 01	0.1640112E 01	0.1120360E 01	0.5200757E 00	0.9926005E 00	133
CV 0.2712478E 00	0.5047482E 00	0.2791417E 00	0.7574122E 00	0.8659062E 00	134
CV 0.2186878E 01	0.6169079E 00	0.7739672E 00	0.7574122E 00	0.2704584E 01	135
CV 0.7997374E 00	0.8238112E 00	0.1731523E 00	0.1362062E 01	0.1186571E 01	136
CV 0.1211549E 01	0.2027483E 01	0.3038310E 01	0.1472030E 01	0.1298825E 01	137
CV 0.5544081E 01	0.1145908E 01	0.2501799E 01	0.1298825E 01	0.2057874E 01	138
CV 0.2524048E 01	0.1170213E 01	0.1221318E 01	0.4429560E 01	0.5610864E 01	139
CV 0.5748043E 00	0.1089006E 01	0.9030228E 00	0.9074131E 00	0.1702708E 01	140
CV 0.1395375E 01	0.1209477E 01	0.2249748E 01	0.2017449E 01	0.3637290E 01	141
CV 0.2569374E 01	0.7191763E 01	0.2495754E 01	0.5149685E 01	0.4369375E 01	142
CV 0.1477639E 01	0.1150580E 01	0.9543817E 01	0.178604E 02	0.6970232E 00	143
CV 0.6157545E 02	0.1874388E 01	0.3798365E 01	0.2432509E 01	0.2969805E 01	144
CV 0.3099833E 01	0.1180511E 01	0.5416517E 00	0.4334645E 01	0.5509905E 01	145
CV 0.5215419E 01	0.2269835E 02	0.2168253E 02	0.2168253E 02	0.5509905E 146	

\*\*\*\*\* LAST CARD OF STATISTICS DECK \*\*\*\*\*

```

DATA
RUN(66000600), LINES(271,711,2), COL(1,222,2)
END
*PRINTRESULTS
RESULTS DISK
PRINT OUTLINE(TRAIN,TEST), TRAIN(F,C), TEST(F,C,P)
SYMBOLS S,C,O,W,R,A
BRETHOLD6*.01
DATA

```

TEST	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271
TEST	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271

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# **Student Notes**

**for**

**DEMONSTRATION of LARSYS**  
**on a 2780 REMOTE TERMINAL**

**DEVELOPED BY:**  
**TECHNOLOGY TRANSFER**  
**LABORATORY FOR APPLICATIONS OF REMOTE SENSING**  
**PURDUE UNIVERSITY, WEST LAFAYETTE, INDIANA 47907**

DEMONSTRATION OF LARSSYS  
ON A 2780 REMOTE TERMINAL

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Student's Notes

Prerequisites:

- a) List the four kinds of information (without regard to format) contained on a multispectral image storage tape.
- b) Name the three types of cards used in running LARSSYS programs.
- c) Describe the output of at least four of the LARSSYS processing functions discussed in the LARSSYS Software System: An Overview

General Description: This demonstration introduces you to the computer hardware and provides an opportunity to increase your familiarity with the LARSSYS system of programs. You will witness the running of several LARSSYS jobs from a 2780 terminal. During the demonstration you will see:

the 2780 used off-line as a card lister  
login procedure  
user information obtained from LARSSYS control commands  
messages sent to the computer operator from the typewriter  
card information transmitted from the 2780 to the computer  
line-printer output being received  
card-punch output being received  
logout procedure

The demonstration takes about 1 to 1½ hours. You will have ample opportunity to discuss the operations with your instructor during the demonstration. At the end of the demonstration you will be given a listing of the control cards used, the typewriter output and the printer and card-punch output. Examine these materials in some detail to reinforce the basic concepts presented. After you have completed this step, arrange a conference with your instructor.

Objectives: Upon completion of the demonstration you should be able to:

1. Explain the local sign-up procedures.
2. Name the person who acts as terminal coordinator and the person to be contacted if the printer is out of paper or if another malfunction occurs.
3. While standing in the remote terminal area, point to:  
the printer (and the printer control panel)  
the card reader/punch (and the mode switch)  
the typewriter terminal  
the LARSYs User's Manual
4. Describe in a few words:  
the use of the 2780 as an off-line card lister  
the use of the typewriter for input and output  
the use of the card reader/punch for input and output  
the use of the line printer for receiving output
5. Explain in general terms the use of LARSYs Control Commands to:  
log in, log out  
initialize LARSYs control system  
start processing LARSYs control cards  
obtain user assistance information (e.g., latest system news, listings of control commands).
6. Using the typewriter output, point out when the system was in CP command environment, LARSYs command environment, or LARSYs processor environment.
7. Using the typewriter output, name two kinds of user assistance information provided by LARSYs without being requested by the user.
8. With the listing of the control cards used in the demonstration:
  - correctly identify each control card as an Initialization Function Card, a Function Selector Card or a Function Control Card.
  - compare the listing against the REFERENCE ALL output to verify the completeness of the control card decks.
9. Locate typical information in the line-printer output.
10. Locate the ID card in the card-punch output.

Note: It is not intended that you be able to run LARSYs jobs unaided at the completion of this demonstration. The next unit in the LARSYs Educational Package, the "Hands-on" exercise, will help you learn the necessary steps for doing that.

## LARSYS Demo Student's Notes

During your preliminary talk with your instructor, fill in the following information for future reference.

LARSYs Demo  
Student's Notes

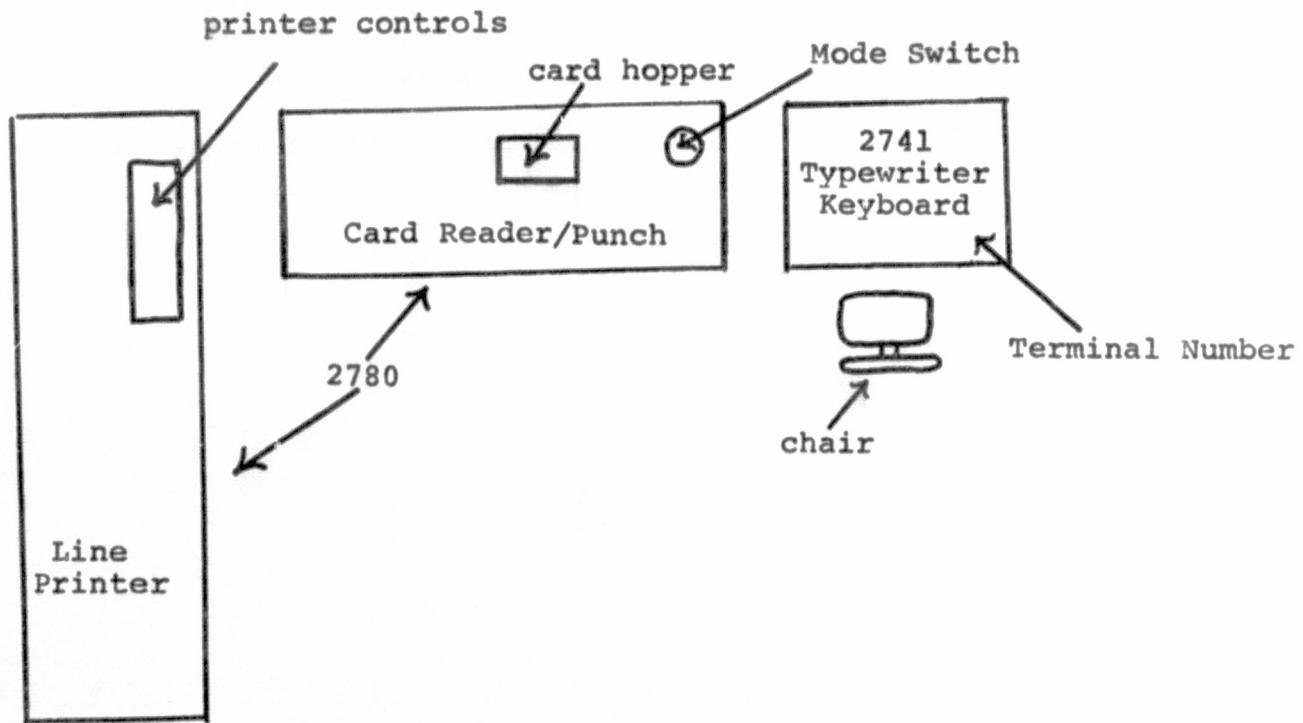
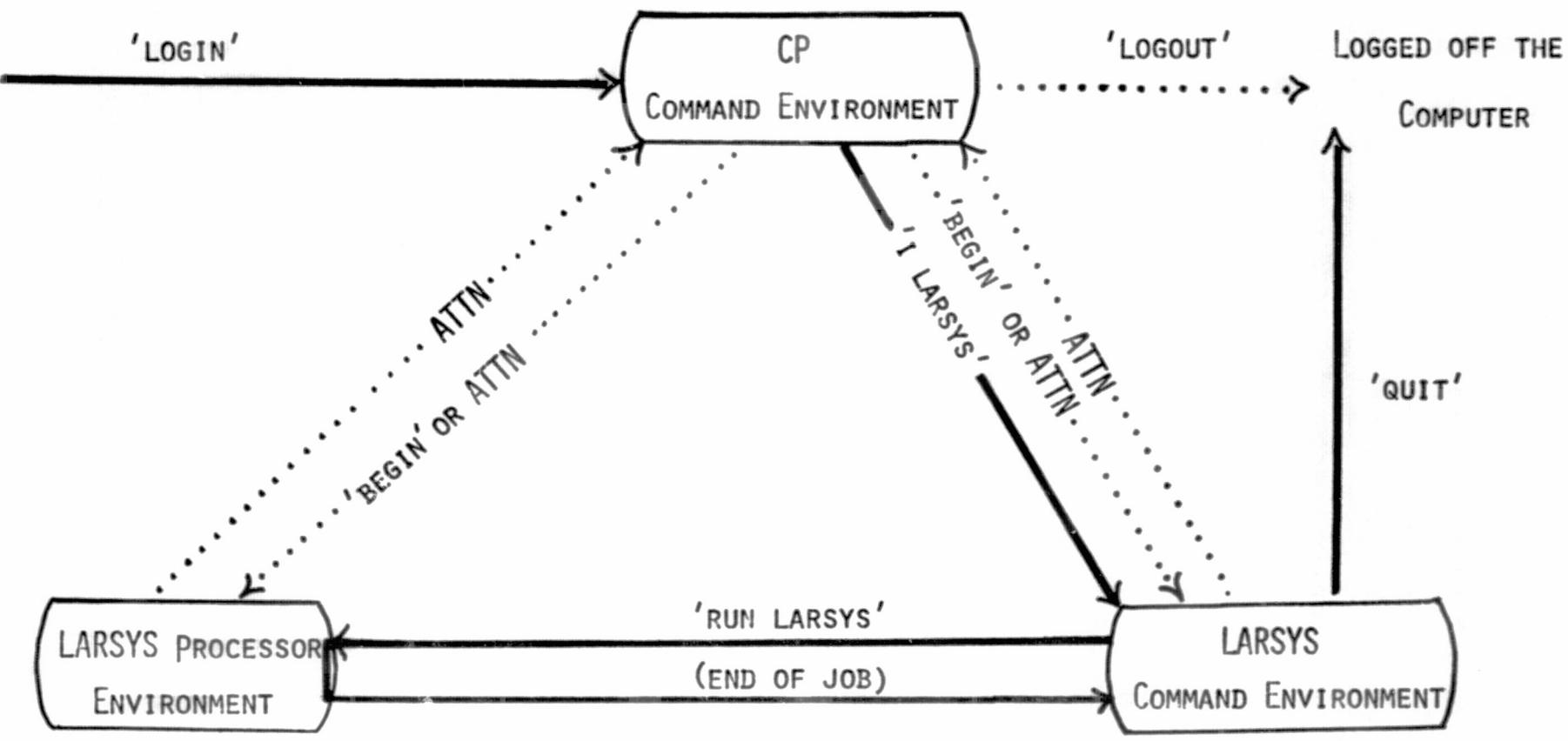


Figure 1

Typical Layout of the Terminal Area



— SOLID LINES SHOW NORMAL TRANSITION PATHS  
 ..... DOTTED LINES SHOW ALTERNATE TRANSITION PATHS

Figure 2. LAR SYS Computer System Environment Diagram

LARSYS Demo  
Student's Notes

After the demonstration . . . . .

Go over the output that you have received:

1. Using the typewriter output:

a) mark on the output when the system was in CP (Control Program) command environment, LARSYS command environment, or LARSYS processor environment.

b) locate each of these six steps

Step 1: log in  
Step 2: enter password  
Step 3: enter your name  
Step 4: initiate LARSYS  
Step 5: run LARSYS  
Step 6: log out

c) point out an example of a progress message  
d) point out an example of an error message

2. Using the line-printer output:

a) Identify each control card on the card listing as an Initialization Function Card, a Function Selector Card or a Function Control Card.

b) Compare the listing for STATISTICS, CLASSIFYPOINTS, and PRINTRESULTS with the deck specifications in your REFERENCE ALL output. (You might find it useful to trim the REFERENCE ALL output, separate the pages, and staple them together for future use.)

c) Locate in the output from STATISTICS where the training fields are identified, the mean and standard deviation vectors and correlation matrices, and the histograms for soybeans, for corn, for oats, for wheat, and for red clover.

d) Locate in the output from CLASSIFYPOINTS and PRINTRESULTS the classification map with training and test fields outlined; locate performance percentages for training and for test fields.

3. Using the card-punch output:

a) Identify the ID card, which appears with all LARSYS punched output. It can be recognized by the solid punching in columns 69-80. It is not considered part of the deck and must be removed before the deck is used as input to other processing functions.

When you have completed the above steps, make an appointment to meet with your instructor.

THE 2780 REMOTE TERMINAL:  
A "HANDS-ON" EXPERIENCE

Instructor's Notes

Materials required: Student's Notes  
Instructor's Notes  
Audio tape, cassette tape recorder  
Punched Cards for listing  
LARsys User's Manual

Estimate of Instructor Time Required:

Briefing student on the preparation of his control cards:  
5 min.

Checking control cards: 5 to 10 min.

Getting the student set up, explaining the use of the  
tape recorder and general procedure to be followed:  
10 Min.

You will need to be available for help during the time the  
student is at the terminal.

Terminal Sign-up and Tape Drive Requirements:

Have student sign up for two hours of terminal time. One  
tape drive is needed; follow current policy for reserving  
it.

Instructional Objectives:

The student will obtain a copy of the instructional objectives  
for this unit when he lists the punched cards provided. For your  
information, this listing is included on page 3 of these Instruc-  
tor's Notes.

Before going to the terminal:

1. Check to see that one of the Multispectral Image Storage Tapes  
assigned to your terminal site has a copy of run 66000600 on  
it. If it does, enter the tape number and file number below  
for easy reference:

Tape TTT = \_\_\_\_; FILE F = \_\_\_\_.

If it does not, see page 6 of A Survey of the LARsys Educa-  
tional Package.

2. Give student the notes which accompany this unit and check to  
see that he meets the prerequisites.
3. See if your student has a user ID and password assigned to  
him. If not, assist him in getting them assigned.
4. Tell him where he can find the LARsys User's Manual.
5. Give student the computer tape number and file number used at  
your remote site for run 66000600, and suggest he record them  
on page 1 of his notes. Have him punch the control card decks  
shown on pages 2-3 of the student's notes. (Show student how  
to punch and duplicate cards on the key punch if he is not  
familiar with it).
6. Check over the student's control card decks for errors.

At the terminal

1. Make sure the terminal is powered up.
2. Explain to the student the general procedure for using the audio tape and notes at the terminal and help him get set up. The student will be more comfortable doing the exercise if his tape recorder has earphones and batteries so that he can move around in the terminal area and not bother others working there.
3. Reassure student that malfunctions caused by the hardware may occur; he should not feel that when things go wrong it is necessarily his fault.
4. Start student on his way; answer questions as they arise. Watch long enough to see that he can load cards into the hopper, 9-edge down, using card weight. (See Figure 2 in Student's Notes)
5. If others are using the terminal, explain to them that your student is using the terminal for the first time and that, while it is nice to "help out," the student should be allowed to push all the buttons and retrieve all the output himself.

After the exercise

1. Talk with the student to determine how he did and his reaction to his "Hands-On" experience.
2. Make plans for working on the next unit in the sequence, the LARsys Exercises.

\*\*\*\*\* LISTING DECK FOR 2780 HANDS-ON EXPERIENCE \*\*\*\*\*

OBJECTIVES FOR 2780 HANDS-ON EXPERIENCE

BY THE TIME YOU FINISH WITH THE TERMINAL TODAY YOU SHOULD BE ABLE TO  
USE THE 2780 OFFLINE AS A CARD LISTER

LOGIN

USE THE LAR SYS CONTROL COMMANDS TO

A) OBTAIN THE LATEST NEWS FILES FOR ANY OF THE FOLLOWING

SYSTEM  
LAR SYS  
SCHEDULE

B) OBTAIN THE LATEST CONTROL CARD LISTINGS FOR THE LAR SYS FUNCTIONS  
RECEIVE PRINTER OUTPUT

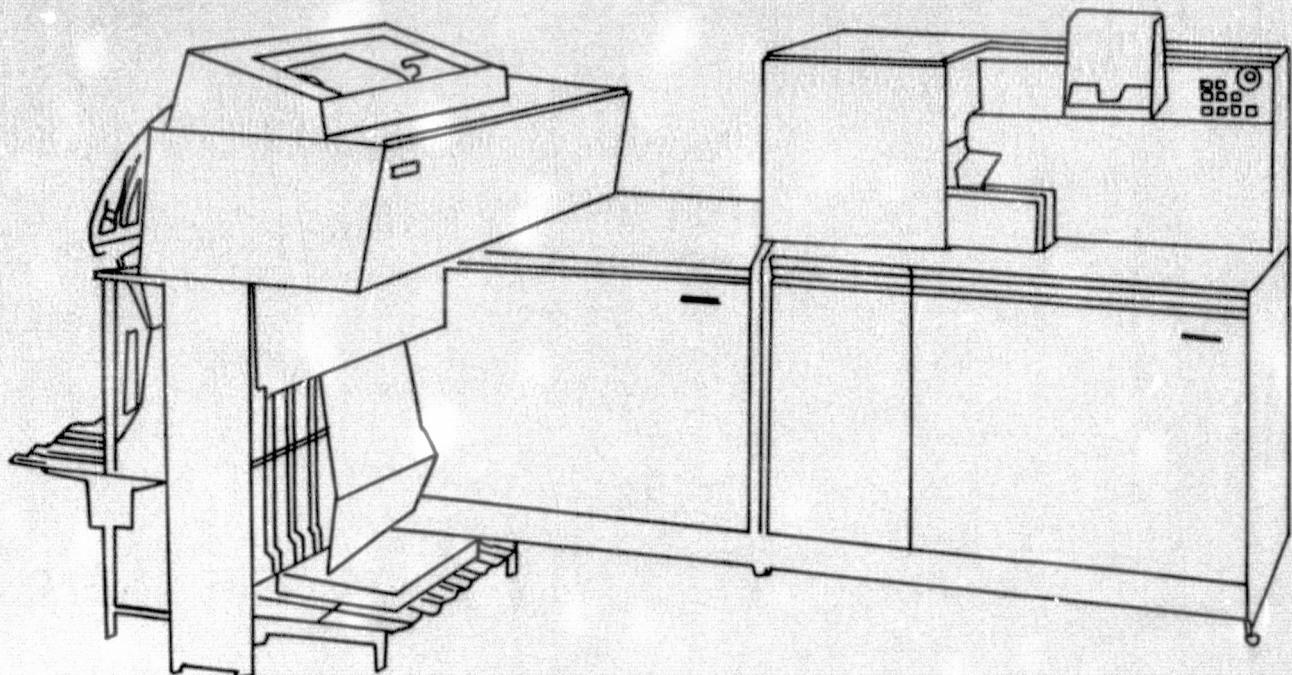
TRANSMIT A DECK OF CARDS

RECEIVE PUNCHED OUTPUT

COMMUNICATE WITH THE COMPUTER OPERATOR OR A USER VIA  
THE REMOTE TERMINAL NETWORK

\*\*\*\*\*END OF HANDS-ON LISTING DECK\*\*\*\*\*

Student Notes  
for  
**THE 2780 REMOTE TERMINAL**  
**-- A "Hands-on" Experience--**



Developed by:  
Technology Transfer Staff  
Laboratory for Applications of Remote Sensing  
Purdue University, West Lafayette, Indiana 47907

THE 2780 REMOTE TERMINAL:  
A "HANDS-ON" EXPERIENCE

---

Student's Notes

Prerequisites:

- a) Satisfactory completion of Units 1, 2 and 3 of the LARsys Educational Package.
- b) Access to the terminal through the assignment of a user ID and a password.
- c) Basic ability to punch and duplicate control cards on a key punch.

Objectives: You will obtain a copy of the objectives of this minicourse early in your work at the terminal.

Estimated time: Including preparation time, time at the terminal and follow up, most students spend about 4½ hours on this unit.

Before going to the terminal:

- a) Find out from your instructor what tape and file numbers to use for data run 66000600:

Tape TTT = \_\_\_\_\_; File F = \_\_\_\_\_

- b) In order to survey the system capabilities from a "user" point of view, skim Section 2 of the LARsys User's Manual, Volume I.
- c) Punch the 2 decks of cards described on pages 2 and 3 and let your instructor check them for accuracy. The annotations on the right briefly explain the purpose of the cards. Details may be found in the LARsys User's Manual.
- d) Sign up for 2 hours of terminal time at a time when your instructor will be available; reserve one tape drive according to current policy.

Control Cards for First LARSYS Run

Punched on Card

① ⑩

ID your ID

-COMMENT DEMONSTRATION OF STATISTICS FUNCTION

This comment will appear at the top of your printer output.

-RUNTABLE

DATA

RUN(66000600), TAPE(TTT), FILE(F)

END

\*STATISTICS

PRINT HIST(C), CORRE(C)

PUNCH CHARACTERS

CHANNELS 1,2,3,4,5,6,7,8,9,10,11,12

OPTIONS HIST(1,8,12)

DATA

CLASS SOYBEANS

①	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱
66000600	31-13	237	253	1	141	167	1	SOYBN
66000600	36-7	307	327	1	59	81	1	SOYBN

Punch these field description cards using the columns indicated. The following cards define the corn training fields; use the same columns.

CLASS CORN

66000600	36-9	267	283	1	45	61	1	CORN
66000600	36-8	319	341	1	21	31	1	CORN

END

Signifies end of function

Put a rubber band around the above deck of cards. They will be used in your first LARSYS job.

### Control Cards for Second LARSYS Run

1

**ID** *your ID*

## -COMMENT DEMONSTRATION OF IDPRINT AND PICTUREPRINT FUNCTIONS

-BUNTABLE

## DATA

RUN (66000600), TAPE(TTT), FILE(F)      Use same tape and file number you used before.

END

\*IDPRINT

PRINT RUN (66000600)

END

\* PICTUREPRINT

Requests ID record of run 66000600.

DISPLAY RUN(66000600) - LINE(1-199-2) COL(1-222-2)

#### HISTOGRAM COMBINE

Requests that histograms be computed.

### RUNCH HISTOGRAM

Punch histogram file in binary format.

BLOCK RUN(66000600), LINE(1,1001,2), COL(1,222,4)

Gives area for histogram.

CHANNEL 6

Signifies channel desired.

END

Signifies end of function.

Put a rubber band around this deck. It will be used to run your second set of LARNSYS functions.

Materials required at the terminal:

- 2 decks of punched cards you prepared as specified on pages 2 and 3.
- 1 deck of punched cards supplied in the unit box.
- 1 audio tape "The 2780 Remote Terminal - a 'Hands-On' Experience."
- 1 cassette tape recorder, preferably equipped with earphones and batteries.
- 1 experienced instructor to start you off and to be available if you run into difficulties
- 1 copy of LARsys User's Manual - there should be one near the terminal.

Outline of Terminal Session

- Part 1. Introduction and Orientation to terminal layout
- Part 2. Using the 2780 off-line as a card lister
- Part 3. "Login," enter name, and initiate the LARsys system.
- Part 4. Run sample LARsys jobs

Normally students can complete their work at the terminal in an hour, although that time may be doubled during the "heavy use" hours.

Begin the exercise by having your instructor explain the use of the tape recorder and general procedure to be followed during the unit. He should let you know where he can be reached while you are at the terminal, and you should not hesitate to ask him for help.

Stand in the remote terminal area and start the tape recorder

## Part 1 - Introduction and Orientation to hardware layout

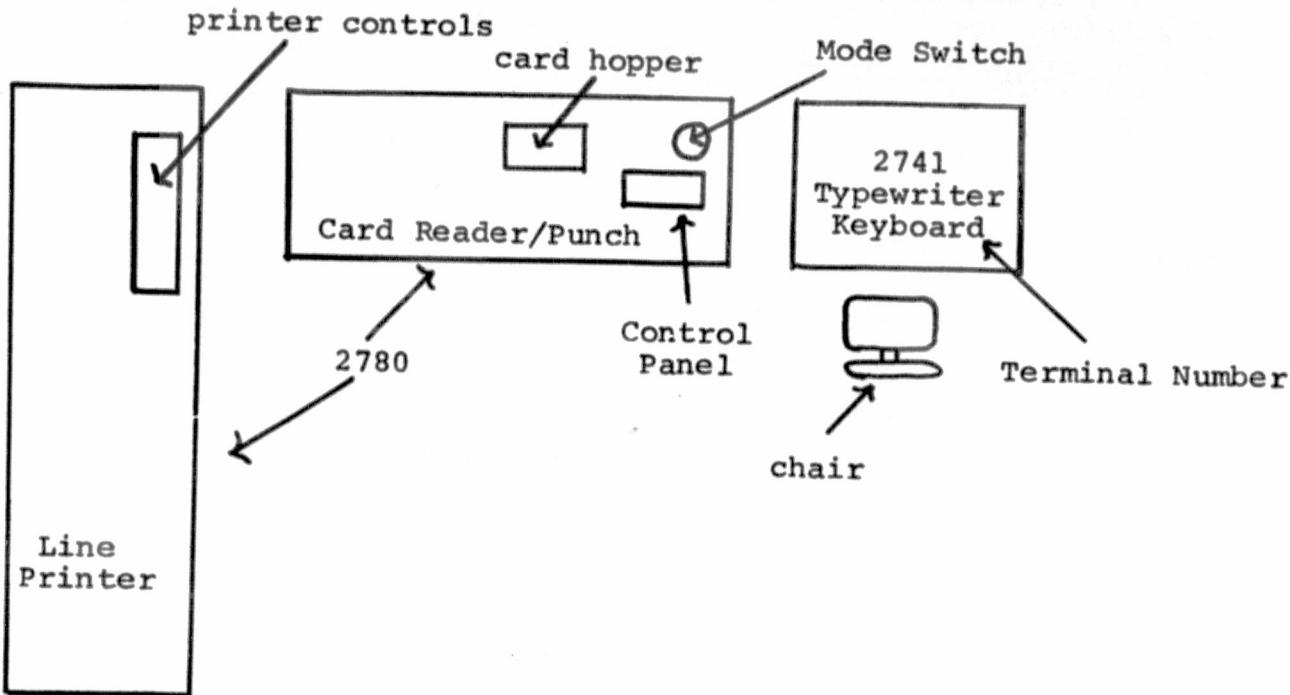


Figure 1

### Typical Layout of the Terminal Area

Part 2 - Using the 2780 off-line as a card lister

Standing in front of the card reader/punch unit:  
push STOP button on card reader/punch control panel  
set mode switch to "off-line"  
load "listing deck" cards as directed on tape (see Figure 2).

Heed the warning on tape: if you get a card reader malfunction, try the procedure given in Appendix A. If that doesn't work, get your instructor to help.

Go to the printer controls and press the START button.

Go back to card reader unit; press and hold the START button until the green light comes on.

**WARNING:** When the printer is in operation, the user must avoid moving the mode switch. To halt operation of the printer, press the CARRIAGE STOP button on the printer.

After the cards have finished, remove the cards from the card reader and press the NPRO (Non-Process Run Out) button to "clear" the card reader.

Then walk over to the printer and push CARRIAGE STOP button, press CARRIAGE RESTORE button on printer a few times, remove the printer output, and read over the Objectives for this unit. They have just been printed from the cards.

The above steps are summarized in Appendix B, page 17.

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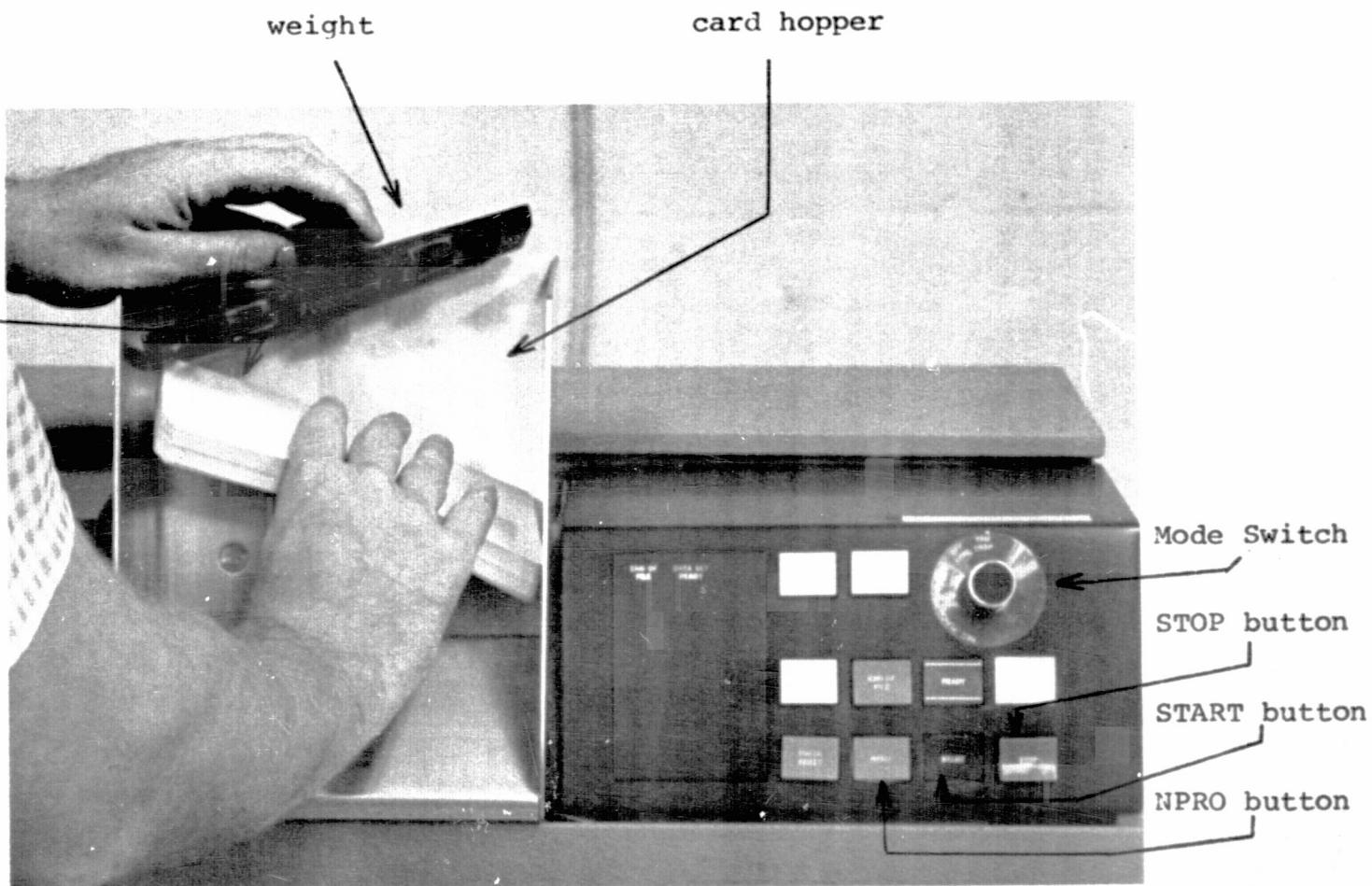


Figure 2  
Loading Cards into the Card Hopper

Part 3 - "LOGIN" and initiate the LAR SYS System

Sit in front of the keyboard; locate these notes so they will be handy

If you make a typing error, see Appendix A.

press ATTN  
you type (and press RETURN)  
computer responds  
type password (and press RETURN)  
type your name (and press RETURN)

login userid ←  
ENTER PASSWORD: ←  
\*\*\*\*\* ←  
ENTER NAME: your name ←  
OPERATORS ARE: MIKE, BOB, AND WAYNE.

\*\*\*NEXT SHUTDOWN: SATURDAY AT 15.00 HOURS\*\*\*

READY AT 08.26.47 ON 12/05/74  
CP

i larsys ← type 'i larsys' (and press RETURN)  
LAR SYS (Version 3.1) READY;

T=1.55/2.32 08.27.15 ← type 'news' (and press RETURN)  
news ←

REVISED 09/11/74

A NUMBER OF MINOR ERRORS WERE FIXED IN LAR SYS. THESE INCLUDE PROBLEMS WITH -COMMENT, A FIX IN IDPRINT TO VERIFY THAT THE CORRECT TAPE IS MOUNTED, AND CHECKING FOR CORRECT COLUMNS IN LINEGRAPH. USE THE COMMAND 'NEWS LAR SYS' FOR MORE DETAILS.

T=0.81/1.08 08.27.57

Note: response to the NEWS command changes frequently. You will get a different message than the one shown here.

news larsys ←  
T=0.83/1.13 08.33.08

type 'news larsys' (RETURN)

Listen for the beep tone, indicating output is ready to come out. Stand up and:

press the STOP button on the card reader/punch control panel  
set mode switch to REC  
press START button on printer.

When printer is finished:

press the STOP button on the card reader/punch  
move mode switch to OFF LINE  
Press CARRIAGE STOP on printer  
press CARRIAGE RESTORE a few times.

Remove printer output.

Return to typewriter terminal.

type 'reference statistics'  
(RETURN)

reference statistics ←  
T=0.93/1.39 08.34.20

To obtain printer output, repeat the same steps you used to obtain "news LARSYS" output.

Part 4 - Sample LARSYS jobs

Review the objectives of this unit.  
Locate your first LARSYS control deck (\*STATISTICS) and move to the card reader.  
Press the STOP button and set mode switch to TSM/TRSP (transmit/transparent)  
Load cards into hopper  
Press END OF FILE  
Press START, holding it until the READY light comes on, cards should read in.

After cards have been read:

press the STOP button to stop the beep  
clear reader by pressing NPRO  
remove cards from the reader

\*\*CARDS XFERED BY FLEXLAB1\*\*  
T=1.90/3.76 08.38.31  
run larsys ←  
EXECUTION BEGINS...

I0198 STATISTICS FUNCTION REQUESTED (STASUP)  
I0034 ALL CONTROL AND DATA CARDS HAVE BEEN READ (STAINT)  
I0200 TRAINING FIELDS NOW BEING PROCESSED. (STAINT)  
I0201 STATISTICS BEING CALCULATED FOR CLASS SOYBEANS (LEARN)  
I0002 TAPE 0445 HAS BEEN REQUESTED ON UNIT 0181 (MOUNT)  
DEV 181 ATTACHED  
I0003 TAPE READY...EXECUTION CONTINUING (MOUNT)  
I0036 DESIRED RUN FOUND...66000600 (GADRUN)

CP ← press ATTN

msg operator I am learning to use the terminal. Please respond when you get this message.

sleep ← type 'sleep' (RETURN)

(operator will respond)

type on one line - - -  
'msg operator I am learning to use the terminal. Please respond when you get this message.' (RETURN)

CP ← *press ATTN*  
begin ← *type 'begin' (RETURN)*

I0201 STATISTICS BEING CALCULATED FOR CLASS CORN (LEARN)  
I0209 COINCIDENT SPECTRAL PLOT(S) PRINTED, (MULSPC)  
I0208 STATISTICS BEING PUNCHED (PCHSTA)  
I0199 STATISTICS FUNCTION COMPLETED (STASUP)  
I0004 END OF INPUT DECK - RUN COMPLETED (LARSNN)  
T=13.19/16.81 08.45.57

Get your printer output by:  
pressing STOP button and setting mode switch to REC  
press START on line printer.

After output stops:  
press CARRIAGE STOP  
press CARRIAGE RESTORE several times  
remove printer output from printer.

Get your punched output by:  
loading blank cards into hopper  
press and hold START until cards start through the punch  
after punching stops, press STOP to stop beep  
remove and store excess blank cards  
press and hold NPRO to clear reader punch unit  
remove punched cards.

There is one more function to be run

run larsys ← *type 'run larsys' (RETURN)*

Notice appearance of "beep tone." Secure your printer output.  
Discussion - why the error occurred.

For E-messages (error messages) and I-messages  
(information messages) refer to Appendix III  
in Volume 3 of LARSYS User's Manual

To correct the error -  
Locate your second deck (\*IDPRINT and \*PICTUREPRINT),  
load into the card reader, and read in.

\*\*CARDS XFERRED BY FLEXLAB1\*\*  
T=14.50/18.31 08.50.31

(RETURN)

type 'run larsys' (RETURN)

run larsys ←  
EXECUTION BEGINS...

I0065 IDPRINT FUNCTION HAS BEEN REQUESTED. (RUNSUP)  
I0002 TAPE 0445 HAS BEEN REQUESTED ON UNIT 0181 (MOUNT)  
DEV 181 ATTACHED  
I0003 TAPE READY...EXECUTION CONTINUING (MOUNT)  
I0114 IDPRINT FUNCTION COMPLETED. (RUNSUP)  
  
I0092 PICTUREPRINT FUNCTION REQUESTED (PICSUP)  
I0237 ALL CONTROL CARDS FOR PICTUREPRINT HAVE BEEN READ (PICRDR)  
I0082 100 LINES HISTOGRAMMED. (HISTD)  
I0082 200 LINES HISTOGRAMMED. (HISTD)  
I0082 300 LINES HISTOGRAMMED. (HISTD)  
I0082 400 LINES HISTOGRAMMED. (HISTD)  
I0091 END OF FILE REACHED ON MULTISPECTRAL IMAGE STORAGE TAPE. (LINE)  
I0084 HISTOGRAM(S) READY TO BE PUNCHED. (HISTD)

press ATTN

CP ←

type 'msg yourid this is a  
test message' (RETURN)

msg yourid this is a test message

FROM YOURID: THIS IS A TEST MESSAGE

type 'begin' (RETURN)

begin ←

I0098 100 LINES DISPLAYED FOR CHANNEL 6 (PIC1)  
I0093 PICTUREPRINT FUNCTION COMPLETED (PICSUP)  
T=31.83/46.17 09.14.56

(continued on next page)

*type 'quit' (RETURN)*

quit ←  
CONNECT= 00:51:40 VIRTCPU= 000:32.26 TOTCPU= 000:46.74  
LOGOUT AT 09.18.23 ON 12/05/74

cp-67 online xd.65 qsyosu

Obtain your printer output. See Appendix D if you need  
more detailed instructions.

Obtain your punched output. See Appendix D if you need  
more detailed instructions.

After the session at the terminal

1. Save these notes, your typewriter output and your printer output for future reference.
2. There are some features of the punched output decks you received that you should be familiar with:

First take the ID card off the front of each deck; it is not considered part of the deck. Duplicate it on the keypunch and check that your ID and name are on the card.

Next duplicate (using the key punch) the first and last card of each deck; now you will be able to "read" the punches. Write down what you find there.

Statistics Deck:

1st card \_\_\_\_\_

last card \_\_\_\_\_

Histogram Deck:

1st card \_\_\_\_\_

last card \_\_\_\_\_

\*The two punched decks serve as examples of two types of deck format: character and binary. The first card in the Statistics deck identifies the format chosen by the user.

If column 44 contains a 0, the deck is a character deck.  
If column 44 contains a 1, the deck is a binary deck.

This Statistics Deck is in \_\_\_\_\_ format.

The Histogram Decks are in binary format.

\*The decks are numbered so that they can be reassembled if they are dropped.

-The cards in the Statistics Deck have sequence numbers in columns 73 - 80 beginning with number 1.

-The cards in the Histogram Deck are also numbered in ascending order, but they are not numbered consecutively.

3. After examining your typewriter, printer, and punched output, let your instructor know how you did on the unit and make plans for doing the LARsys Exercises, Unit 5.

Appendix A: MALFUNCTION RECOVERY PROCEDURES

Cards Won't Read

<u>Condition</u>	<u>Probable Cause</u>	<u>Recovery</u>
A few cards read then reader stops; no additional lights come on and there are no beeps	No ID Card	Remove cards from hopper Press NPRO* button and hold for a few seconds Gather any cards that have come out of the reader Reassemble your deck with your ID card on the front, reload the hopper, and try again
Cards start reading and the "hopper" light comes on	Cards bent, torn or uneven	Remove cards from the hopper Press the NPRO* button and hold for a few seconds Put a blank card in hopper, press EOF** button, read in blank card Go to typewriter, push RETURN (you should receive a message that cards have been transferred) Type 'clear reader' RETURN (these steps remove the partial deck that had already been read in) Check original deck for bent or torn cards and make new cards where needed Read deck in again. If you still can't get the cards to read after three attempts, check with your instructor

In all other cases, see your instructor

System Error Messages

?CP-system is in the CP command environment; you have just typed an invalid CP command.

E116-'COMMAND' IS NOT A VALID CONTROL COMMAND (EXCOMD)  
System is in the LARSYS command environment; you have just typed an invalid command.

All system error messages are identified in Appendix III (Vol. 3) of the LARSYS User's Manual.

---

\*NPRO stands for non-process run out.

\*\*EOF stands for end-of-file.

Typing Errors

One (or up to several) letter(s) in error.  
type an @ symbol for each letter in error,  
then continue with your message.

Example:

*run larty@@sys* would be interpreted as:

*run larsys*

Deletion of a whole line.  
type \$, then the desired line.

Example:

*news larys\$ reference larsys* would be interpreted as:

*reference larsys*

No EOF sent when Transmitting Cards

If you neglect to press the EOF button before the last card is read, you can recover in the following way:

put a blank card in the hopper  
press EOF, START

To verify successful transmission, press RETURN

Appendix B: USING 2780 AS A CARD LISTER

press STOP on reader/punch unit  
turn mode switch to OFF LINE  
load cards  
press START on printer  
press START on card reader and hold until READY light comes on  
.  
.  
.  
cards will be listed  
.  
.  
.  
clear card reader (NPRO)  
remove cards  
press CARRIAGE STOP on printer  
press CARRIAGE RESTORE on printer  
remove listing

Appendix C: SENDING MESSAGES

Send message to operator

press ATTN  
type 'msg cp' and your message  
press RETURN

Send message to another user

press ATTN  
type: 'msg'  
id of user being addressed  
the message you are sending  
press RETURN

Note: messages sent as described above are limited  
to one line on the typewriter.

Appendix D: TRANSMITTING DATA TO AND RECEIVING DATA FROM THE MAIN COMPUTER

To transmit cards

load cards in hopper; ID card must be first card  
press STOP; turn mode switch to TSM/TRSP  
press END OF FILE  
press and hold START until READY light comes on  
.  
.  
.  
wait until all cards are read  
.  
.  
.  
press STOP; move mode switch to OFF LINE  
press NPRO  
pickup your cards  
press RETURN to get message verifying transfer of cards

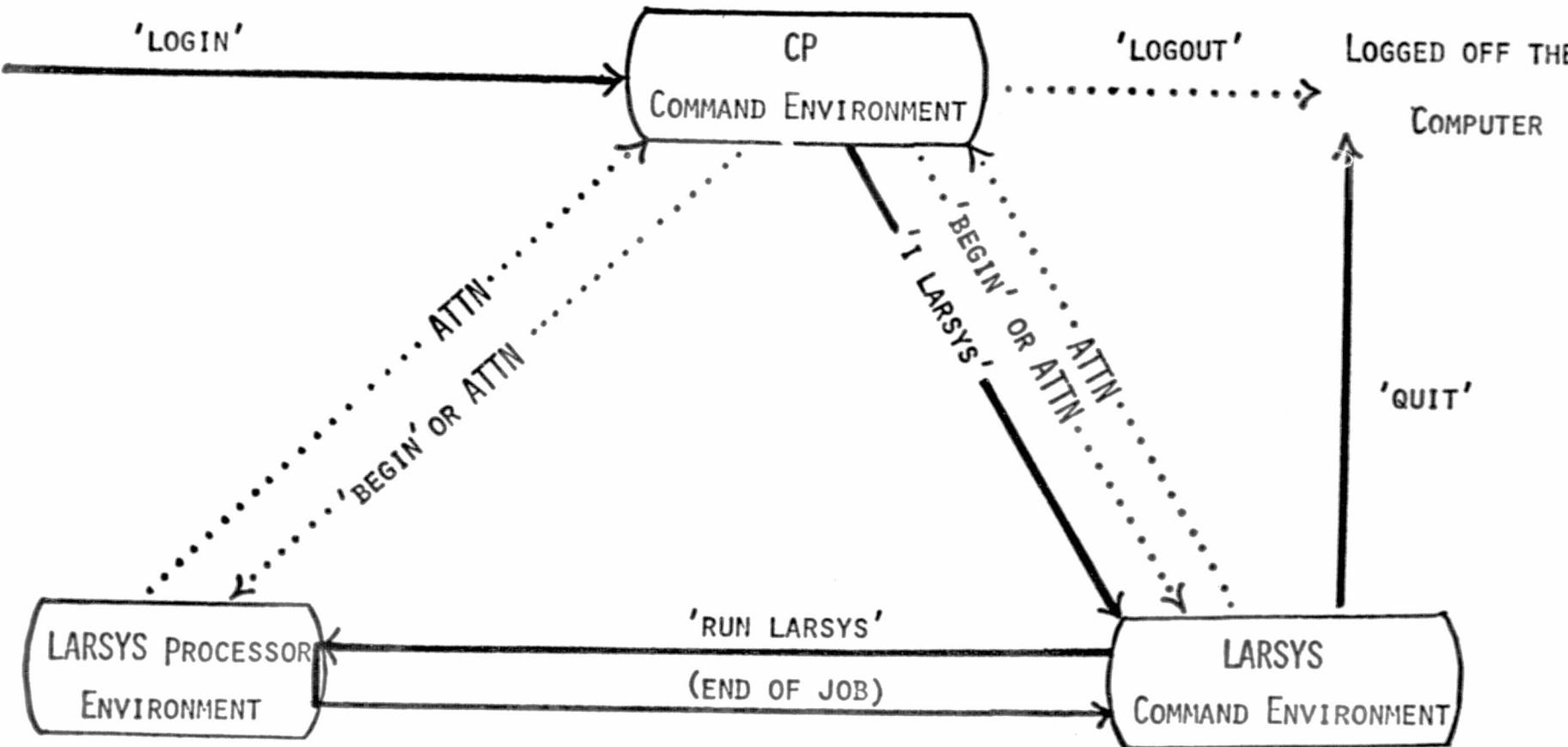
To receive printer output

press STOP; turn mode switch to REC or PRINT  
press START on printer  
.  
.  
.  
wait for output to finish  
.  
.  
.  
press CARRIAGE STOP  
hit CARRIAGE RESTORE a few times  
remove printer output from back of printer  
press STOP; put mode switch in OFF LINE position

To receive punched output

press STOP; turn mode switch to REC or PUNCH  
load blank cards in hopper  
press START  
.  
.  
.  
wait for punching to stop, pick up your cards  
.  
.  
.  
press STOP; turn mode switch to OFF LINE  
remove extra cards  
clear punch by pressing NPRO  
pick up your cards

## Appendix E



LARS Computer System Environment Diagram

Materials Required

Problem statements for students  
Instructor's Notes

General Instructional Procedure

It is suggested that you assign these problems one at a time and interact with the student between problems.

For each problem the recommended approach is to:

- a) Go over the problem statement with the student.  
Discuss which processing function he will be using.
- b) Have student punch the control cards.
- c) Check over the control cards, point out errors or alternative approaches if you wish.
- d) Have student run program.
- e) Discuss results.

Encourage your students to use the LARSYS User's Manual and the LARSYS system features themselves as references. The student may find it helpful if you instruct him how to cancel a job and how to cancel output.

Instructor Time Estimate

Interaction with students before and after each exercise:  
10 to 15 minutes per exercise.

Data Source

In all exercises requiring access to a Multispectral Image Storage Tape, the student should be encouraged to use a personal runtable using the card sequence:

```
-RUNTABLE
DATA
RUN(XXXXXX), TAPE(TTT), FILE(F)
END
```

See "Special Note to Instructor" on page 6 of A Survey of the LARSYS Educational Package at the beginning of this volume for instructions on how to create the data tape for your site.

**Exercise 1: Reference All**

This exercise is intended for all students who did not previously get a complete listing of LAR(SYS Control Commands, Initialization Function Control Cards, and Processing Function Selector and Control Cards.

Log in to the computer, and, after taking care of your ID, password and name and initiating LAR(SYS, type the command:

reference all

Keep the printer listing for future reference.

**Instructor's Notes**

1. Check with your student to see that he has a 'Reference All' listing. If he already has one, skip this problem.
2. No control cards are required. Student merely has to review how to login, get his listing and quit.

**Exercise 2: LARSYS Control Commands**

The purpose of this exercise is to reinforce the login procedure, to give you practice in getting printer output, and to illustrate use of some of the LARSYS Control Commands.

Login and:

- a) obtain the NEWS file pertaining to the system
- b) obtain the SCHEDULE for computer operation
- c) type the command LIST
- d) obtain the RUNTABLE entry for run 72050700

(use your "Reference All" listing to find out which LARSYS Control Command you need to use)

Instructor's Notes

1. No control cards are required for this exercise. It is designed to give the student practice in the login procedure, issuing control commands and obtaining printer output.

Exercise 3: Gray Scale Printouts

The purpose of this exercise is to provide experience building an input deck and running a LAR SYS job in order to acquire specific output. (See page 2-29 in Volume 1 of the LAR SYS User's Manual for general information about card format.) This LAR SYS output also illustrates the informational value of multispectral data.

Set up the control card deck needed to obtain a single-width gray scale printout of lines 750-949, run 66000600, showing channels 1 through 12. Use a COMMENT card so that the output will be labeled.

List your deck off-line and check the listing for errors in card preparation. Correct any such errors.

Run the job.

Instructor's Notes

1. Your student will probably need help in deciding which processing function to use. Try to get him to discover the answer himself, direct him to his REFERENCE ALL output and the LAR SYS User's Manual.
2. If you have two students doing the exercise at the same time, the output could be reduced by having one run the even channels and the other the odd ones.
3. Explain the set-up for a user runtable so that your student will use the tape that has been reserved for instructional purposes at your remote terminal location.

For easy reference run 66000600 is stored on Tape TTT = \_\_\_\_\_;  
File F = \_\_\_\_\_.

4. After your student has completed this exercise, you can use his output to illustrate the value of multispectral data. Show how some field boundaries are more easily detected in certain channels.

5. Point out how you might want to use the PUNCH control card if you expect to make additional gray scale printouts of the same area. (Saves computing the histograms again.)
6. Ask your student if he used the BLOCK card and find out why or why not. Discuss the BLOCK card's function.
7. This exercise creates a lot of output. Discuss with your student the need for restricting output requests so that they call for only what is needed.

**Exercise 4: Graph Columns**

This exercise and the next are designed to give you more experience with LARNSYS and added familiarity with the power of LARNSYS for utilizing the multispectral characteristics of the data.

Graph columns 49, 59, 69, lines 408 to 503, of run 66000600.  
Show data from the .44-.46, .62-.66 and .80-1.00 micrometer channels.

Punch the control card deck and run the job.

**Instructor's Notes**

1. The problem statement emphasizes the wavelength bands of the channels. Student will have to refer to IDPRINT output to find the corresponding channel numbers.
2. Let the student set up the control card deck. As long as it will work, let it run. Afterwards you may want to point out various ways of setting up the control cards so as to get desired types of graphs (not too many plots on one set of axes, etc.)

For easy reference, run 66000600 is stored on Tape TTT = \_\_\_\_\_.  
File F = \_\_\_\_\_.

Exercise 5: Graph Lines

The purpose of this exercise parallels that of the previous one with added experience in using a LAR SYS diagnostic feature.

Graph line 708 of run 66000600.

Punch the control card deck.

Use the -CHECKOUT procedure to check for control card errors. See pages 5-15 through 5-18 (Volume 1) of the LAR SYS User's Manual for a description of this initialization function and pages 3-14 through 3-19 for a step-by-step description of how to use it.

Run the job.

Instructor's Notes

1. Students will have to decide which channels they want.
2. A common blunder is to plot all 12 channels on the same graph. This results in a mass of symbols. Three or four channels per graph works out better.

For easy reference run 66000600 is stored on Tape TTT = \_\_\_\_\_;  
File F = \_\_\_\_\_.

## LARSTYX Exercises

### Instructor's Notes

#### Exercise 6: Color Panels

The purpose of this exercise is to acquaint you with the batch processing mode and to further your understanding of the nature of multispectral data.

Run 66005200 is a low-level flight over a set of color panels on the ground. These panels are used to obtain data which help in calibrating the aircraft scanner data. The panels, located between lines 400 and 1000 and columns 315 and 425, are arranged in two strips. The strip on the left is made up of three colored rectangular panels; the right-hand one is a series of gray panels.

Using the batch processing mode, obtain some representative gray scale printouts of this area and determine the row and column boundaries of the color panels. See pages 2-45 through 2-46 and pages 3-38 through 3-39 of the LARSTYX User's Manual (Volume 1) for information on how to submit a batch run from the terminal.

After you get your gray scale printouts, select a particular panel and obtain lineprinter output of the data values for all points within the panel boundaries. Show the data for a representative set of channels.

Can you tell from the multispectral data the color of each of the three colored panels?

#### Instructor's Notes

1. Before starting student on this problem be sure a copy of run 66005200 is on the tape dedicated to instructional use at your remote terminal location. If a copy is not available you can make one by running

```
*DUPLICATERUN  
FROM RUN(66005200)  
TO TAPE(TTT), FILE(F)  
END
```

For your future reference:

TTT = \_\_\_\_\_, F = \_\_\_\_\_

at this location for run 66005200.

Student should be encouraged to use a personal runtable when running this exercise.

2. This run has only 6 channels. I suggest you let the student stumble into this himself; then point out the value of the ID record (IDPRINT) when working with a new run.
3. Student must decide for himself what a "representative" set of channels is. Channel 5 shows the panels quite well.
4. The data for line 431 does not exist and, if the parameters selected by the student call for this line, a message to this effect will appear on the gray scale printout. Let the student discover this for himself and use the opportunity to point out the many diagnostic features built into LARSYS.
5. Panels are in the vicinity of lines 687-726, columns 340-378. The degree to which the panels show up on the gray scale printouts depends on the size of the area histogrammed.
6. The color panels are red, green, and blue in that order.

**INSTRUCTOR'S OVERVIEW  
OF UNITS VI AND VII**

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**Instructor's Notes**

At this point in learning to use LARSYS, the student has available two case study units. One case study is geared toward a supervised analysis approach, analyzing aircraft data. The other case study combines techniques from both supervised and unsupervised approaches and applies these techniques to data collected by the Earth Resources Technology Satellite, now known as LANDSAT.

If a student has the time, resources, and interest, a study of both units is recommended. If not, you should help the student decide which one will be more useful. The philosophy taken in preparing these case studies is described in the "Preface to the Student" section of each document. Please read this material.

In working through either case study, it is important that the students state clearly the objectives of their analyses. Discuss the chosen objectives with the student. A number of readings are suggested from the site library. Make sure that your student knows the local procedures for gaining access to the materials.

We recommend that you monitor the progress of your students frequently. Try to arrange frequent student/instructor conferences of short duration, since experience has shown they are more beneficial than lecture sessions of longer duration. These conferences are particularly important in the case study analyzing LANDSAT data.

Included in the site library is one solution to each case study. "An Analysis of Run 71053900" is the aircraft data analysis, and "An Analysis of Run 73033802" is the satellite data analysis. These solutions are NOT presented as "the correct solutions" but rather as example solutions. Since the analysis of remotely sensed multispectral data is a developing science, you should not expect your student's analysis to match the results of the solution we have provided.

Also provided as part of your "instructor's kit" are decks of Field Description Cards for the test fields used in the solutions provided. The test deck for the aircraft data analysis is not intended to replace student-selected test fields, but rather to serve as an additional evaluation tool if, for instance, several students are going through at once and you want a comparison test deck. The test deck for the satellite data analysis is provided for use by all students, to save them the time they would spend selecting their own test fields.

## GUIDE TO MULTISPECTRAL DATA ANALYSIS USING LARST

### Instructor's Notes

#### Materials Required

1. Student copy of Guide to Multispectral Data Analysis using LARST by J.C. Lindenlaub (LARS Information Note 062873)
2. Student copy of Pattern Recognition Notes by P.H. Swain (LARS Information Note 111572)
3. Reference copy of LARST User's Manual
4. Reference copies of LARS Information Notes:  
120371 - The Importance of Ground Truth Data in Remote Sensing by R.M. Hoffer  
102670 - Random Noise in Multispectral Classification by S. Whitsitt  
062273 - Analysis Research for Earth Resource Information Systems: Where Do We Stand? by D.A. Landgrebe  
020871 - Comparison of the Divergence and  $\beta$ -Distance in Feature Selection by P.H. Swain, T.B. Robertson and A. Wacker
5. "An Analysis of Run 71053900" with Field Description Cards for test fields.
6. Multispectral Image Storage Tape: Check to see that one of the data tapes assigned to your terminal site has a copy of run 71053900 on it. If it does, enter the tape number and file number below for easy reference:  
Tape TTT = \_\_\_\_\_; File F = \_\_\_\_\_  
If it does not, see page 6 of A Survey of the LARST Educational Package.

#### Additional References

Examples of results analysis and the extraction of useful information from multispectral data classifications may be found in journals such as:

Remote Sensing of the Environment  
IEEE Transactions on Geoscience Electronics  
Remote Sensing in Ecology  
Journal of Soil and Water Conservation  
Photogrammetric Engineering and Remote Sensing  
Agronomy Journal  
Applied Optics

as well as in a number of LARS Information Notes, and published proceedings of remote sensing conferences.

Instructor's Notes

The philosophy taken in preparing this part of the LARSYS Educational Package is described in the "Preface to the Student" section of the document. Please read this section.

It is suggested that you monitor the progress of your student frequently - you should plan on talking to him at least once during each step of the analysis sequence. Experience indicates that frequent student/instructor conferences of short duration are more beneficial than longer duration lecture sessions.

Students need to state their objectives clearly for the case study.

Each remote terminal site has been provided with a copy of "An Analysis of Run 71053900." The analysis of remotely sensed multispectral data is a developing science and you should not expect your student's analysis to match the results of the "school solution" we have provided. There is no single "correct" analysis. In particular, it is doubtful that a person analyzing a flightline for the first time would obtain as high a degree of correct classification as has been achieved on the analysis provided to you. Consider our solution a "crutch" but not an "authority."

A CASE STUDY USING LARSYS FOR  
ANALYSIS OF LANDSAT DATA

Instructor's Notes

Materials Required

1. Student copy of A Case Study Using LARSYS for LANDSAT Data by Tina K. Cary and John C. Lindenlaub (LARS Information Note 050575)
2. Student copy of Pattern Recognition: A Basis for Remote Sensing Data by Philip H. Swain (LARS Information Note 111572)
3. Reference copy of LARSYS User's Manual
4. Reference copies of LARS Information Notes:  
120371 - The Importance of Ground Truth Data in Remote Sensing by R.M. Hoffer  
011069 - Ecological Potentials in Spectral Signature Analysis by R.M. Hoffer and C.J. Johannsen  
042673 - Two Effective Feature Selection Criteria for Multispectral Remote Sensing by P.H. Swain and R.C. King  
062873 - Guide to Multispectral Data Analysis Using LARSYS by J.C. Lindenlaub  
110474 - An Introduction to Quantitative Remote Sensing by J. Lindenlaub and J. Russell  
072473 - Emission and Reflectance from Natural Targets by R. Kumar and L. Silva  
100771 - The Minimum Distance Approach to Classification by A.G. Wacker and D.A. Landgrebe
5. "An Analysis of Run 73033802" with field description cards for test fields.
6. Reference Data: Three kinds of reference material are needed for the case study:
  - a) Six U.S. Geological Survey 7.5 minute quadrangle maps covering the area analyzed in the case study. These are not provided as part of the site library. The site techniques specialist should be responsible for ordering these maps. Three or more sets of maps per site are recommended. The maps may be ordered from Distribution Section, U.S. Geological Survey, 1200 South Eads Street, Arlington, Virginia, 22202. The names of the sheets required are:  
Oolitic, Indiana  
Bartlettsville, Indiana  
Clear Creek, Indiana  
Allen's Creek, Indiana  
Bloomington, Indiana  
Unionville, Indiana

A set of the USGS maps should be loaned to the students during their study and collected from them afterward.

- b) Monroe County, Indiana highway maps. Ten of these are provided per site. They are to be lent to the students during their study and collected from them afterward.
- c) Color infrared aerial photograph in 35 mm slide format. Ten slides are provided for each site. Again, they are intended to be loaned to the students and collected from them upon completion of the case study.

7. Multispectral Image Storage Tape: Check to see that one of the data tapes assigned to your terminal has a copy of runs 73033802 and 72072302 on it. If it does, enter the tape number and file number below for easy reference:

73033803 Tape TTT = \_\_\_\_\_; File F = \_\_\_\_\_  
72072302 Tape TTT = \_\_\_\_\_; File F = \_\_\_\_\_  
If it does not, see page 6 of A Survey of the LARsys Educational Package.

#### Additional References

Examples of results analysis and the extraction of useful information from multispectral data classifications may be found in journals such as:

Remote Sensing of the Environment  
IEEE Transactions on Geoscience Electronics  
Remote Sensing in Ecology  
Journal of Soil and Water  
Photogrammetric Engineering and Remote Sensing  
Agronomy Journal  
Applied Optics

as well as in a number of LARS Information Notes and published proceedings of remote sensing conferences.

#### Instructor's Notes

As mentioned earlier, student/instructor interaction is an important part of this case study. It is recommended that you meet with your students after each step in the analysis. At the beginning of the case study you will want to make sure that each student knows about the various reference materials and their availability.

## ANALYSIS FLOWCHART

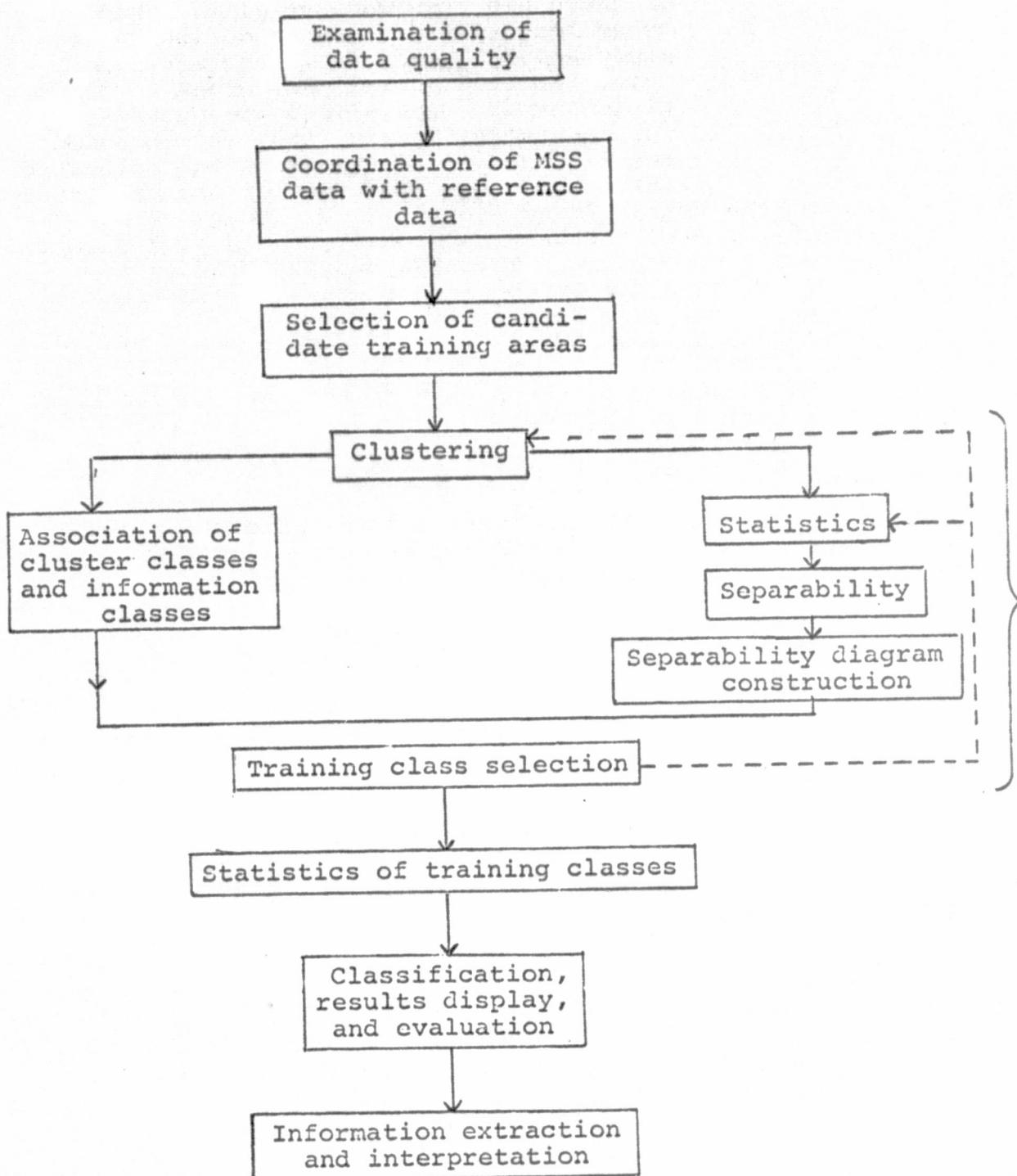


Figure 2. Flowchart indicating the sequence of steps undertaken in the analysis procedure described in this manual.

The following comments relate to the analysis flowchart for the case study which is reprinted on page three for your convenience.

In the examination of data quality and coordination of the multispectral scanner data with reference data, the student is told in the case study that the data tape he will be working with has been geometrically corrected and scaled to match the scale of the USGS 7.5 minute quadrangle maps. However, no mention has been made of the fact that in order to get proper matching a double printout employing every line and column should be used. It might also be helpful for you to know that if every other line and column is used, the scale approximates the scale of the Monroe County highway map.

The case study material suggests in the section on selecting training areas that each training area should contain more than one cover type. Some students will perhaps inquire why you can't select areas that are "pure" in the sense that they contain only one cover type. An obvious example here is to select an area from the middle of the reservoir which is certain to contain only the water cover type. Although this procedure can be used to carry out the case study, it is suggested that you encourage students to include more than one cover type. The reason for doing this is: when the clustering algorithm uses all four channels of data, the cluster map which is produced may be thought of as an enhanced image. That is, a map obtained by using data from all four bands might be expected to do a better job of delineating boundaries between cover types than any single-channel gray scale map. An area which includes a fairly large portion of the reservoir along with some shoreline area should illustrate this point.

It is suggested that you place the burden of decision upon your students in selecting candidate training areas. There are a number of approaches, and some work better than others, but we have found that students gain by their mistakes and seldom make the same mistake twice. Examples of typical blunders in selecting candidate training areas are the following:

- a) Selecting areas on gray scale printouts and then discovering later on that the areas that they selected happened to fall in the cloud shadow area of the aerial photograph, thus making it impossible to establish cluster-class/information-class associations.
- b) Not selecting areas with distinctive geometric features, such as a bend in the river or a peninsula jutting out into the reservoir, thereby making the process of overlaying the aerial photograph and the cluster maps more difficult.

Here again, it is suggested that you let students discover these errors for themselves. If they don't use the best

techniques the first time, you can point out some of their weaknesses and suggest improved techniques for use in future analyses.

It would be a good idea to discuss with your students the analysis flowchart after they have completed the clustering operation. As the case study is written, students are encouraged to make cluster-class/information-class associations working from the output of the cluster maps and reference data before running the STATISTICS and SEPARABILITY processors. You might want to point out that it would be possible to proceed on the right-hand branch of the analysis flowchart, that is the statistics, separability diagram construction prior to the time that they make the spectral class/information class associations. Experience with pilot groups of students has indicated that until the students have actually pursued both paths they don't have a full appreciation of the interdependency of these operations.

Although the case study points out that the students should take care in keeping track of the symbols used in SEPARABILITY and being able to relate them to the original cluster symbols, it would not hurt to emphasize this point with them before the SEPARABILITY processor is run.

Interpretation of the separability diagram and final training sample selection will be one of the most frustrating experiences for the students. Your encouragement at this point would be helpful. It must be realized however, that there are no clear-cut, crisp rules that can be used in this part of the analysis. Also, take this opportunity to state that part of the purpose of the case study is to develop experience. If there were strict rules available, it would not be necessary to have highly trained analysts.

In discussing the classification and results display operations with your students, point out that the case study suggests storing the classification results on disk and hence, it is suggested that the students chain several PRINTRESULTS runs immediately after the CLASSIFYPOINTS algorithm has been run. One possibility is to do a PRINTRESULTS which does not group any of the subclasses which they may have defined. This allows students to see the interdependency between the various subclasses. Then follow this with a second PRINTRESULTS operation which groups subclasses into the major cover types so that the test deck which has been provided as part of the case study materials may be used.

Out of seven groups of students that have field-tested this study most of them achieved training data performance results in the low to mid 90% range. Most of the groups achieved test results percentages in the low to mid 80's with considerable confusion between the urban and agricultural classes and to a lesser extent confusion between the forest and agricultural classes. These numbers are given simply

as guidelines. It is certainly possible that a student who achieved only 60% accuracy could learn as much about the case study as a student who achieved an 87% accuracy.

The interpretation of classification results should be discussed with your students. When low accuracies and confusion between certain cover types are evident in the results, this could also arise because the training sets that were finally chosen were not representative of the area being classified. If the situation warrants it and time permits you may wish to have your students iterate through portions of the analysis again.